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Forthcoming Events.

SEPTEMBER 6-18.
Universal Smoke Abatement Exhibition at Birmingham.

SEPTEMBER 13.
Institute of British Foundrymen (Lancashire Branch):—Visit to Messrs. Mather & Platt's Salford Ironworks.

SEPTEMBER 17-25.
Model Engineer Exhibition at Royal Horticultural Hall, Westminster, S.W.

SEPTEMBER 27-OCTOBER 1.
American Foundrymen's Association:—Congress at Detroit, U.S.A.

OCTOBER 4-9.
Motor Cycle and Cycle Exhibition at Olympia, London, W.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Foundry Work and Standardisation.

From the foundry point of view, standardisation is a double-edged sword. Primarily, the man in the street imagines that when something has been standardised it is a finished entity. With the exception of tons, gallons, inches, and similar elementary measuring units, all other "standards" must be regarded as transitory. It is this type of standard which both helps and hinders the foundry owner. Inasmuch as the standardisation of a colliery tub or omnibus wheel in general would induce large-scale orders, the foundryman can figure with a certain amount of security on the installation of specialised machinery, derive exact cost figures and, generally speaking, put the job on a proper quantity production basis. On the other hand, standardisation can be a nuisance, as in certain cases the alteration of a "standard" article becomes so expensive and difficult that although a better design may be available its incorporation industrially becomes almost an impossibility, or at least greatly delayed.

The question of standardisation is one of such importance that no attempt should be made by any person other than the highest technical official of any concern, and even then only with the substantial consent of the directorate or owner.

Take, for instance, the question of motors in a large foundry concern; it seems very desirable that they should all be of one particular make, because the question of maintenance and the provision of spare parts becomes more economical. There are the following dangers: (1) The firm making the type chosen might radically alter their design; (2) go out of business; and (3) increase their prices beyond what could be considered as normal. Again, another firm may provide industry with a generally superior article.

Thus for large-scale plant purchases it seems desirable not only to "standardise" on at least two makes, but reserve a maximum small percentage proportion for various types. Great attention should be paid to the performance of the "non-standardised" plant, as it is just here that important economies can be looked for. If, for instance, a firm has standardised on a hydraulic, a pneumatic, or any other system of moulding, then any small percentage of the plant incorporating "non-standardised" machines deserves special study from an imaginative point of view. This should be done with the object of visualising what the costs would be should the "standard" be changed.

Contrary to what might be expected, attempts to formulate standards have often made for real progress, because research into the existing state of the art has shown clearly inherent defects and paved the way to lasting improvements. The work accomplished with a view to enunciating the tests to be expected from cast iron has directed technical thought into profitable channels.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Cast Iron for Electrical Machines.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In my Paper on "Cast Iron for Electrical Machines," published on page 67 of your issue of July 22 last, curves are given for the magnetic properties of blackheart malleable cast iron, kindly supplied by Ley's Malleable Castings Company, Limited. In the accompanying analysis figures an error has occurred, and I should be glad if you would publish this correction:—

	Total Carbon.	Graphitic Carbon	Combined Carbon.
	Per cent.	Per cent.	Per cent.
MK.	2.29	2.24	0.05
MJ.	2.24	2.16	0.08

The combined carbon figures are supported by the microstructure, Fig. 26, which shows almost complete absence of combined carbon.—Yours, etc.,

J. H. PARTRIDGE.

Chemistry of the Cupola.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In the Paper "Some Notes on the Chemistry of the Cupola," by Professor F. C. Thompson and Mr. L. Becker, published in your issue of June 24 this year, the method of drawing up the theoretical thermal balance sheet for a cupola is given, and a typical example shown.

A description is given of the probable reactions of the gases with carbon in the cupola. At or near the tuyeres CO_2 is the main product. This then reacts with the hot coke immediately above to form CO. As the CO passes up the stack through the cooler charges, there is a tendency for it to be converted to CO_2 and C, this reaction being complete at 400 deg. C. if there is sufficient time for equilibrium to be obtained.

There is, therefore, theoretically, a transfer of carbon from the coke charges near the tuyeres, where the CO is formed, to the coke charges further up the stack, where it is broken up into CO_2 and C. Practically, the question arises, as to whether this transferred carbon is deposited in such a form that it is safely carried down to the zone of combustion; or whether, as the charges drop, it is rubbed or blown off, and carried up the stack, unburnt, by the ascending gases.

The assumption made in the Paper is that the whole of the carbon is burned either to CO_2 or CO.

To take a concrete example: Consider a cupola containing seven complete and equal charges. Assume that by the time the second charge is passed—working up from the tuyeres—all the ascending gas is CO, and that at exit from the cupola there are equal volumes of CO and CO_2. This means that one-third of the carbon burned in the combustion zone is deposited over the top five charges; or, to put it another way, by the time a charge reaches the combustion zone, it will contain, theoretically, one and one-third times as much carbon as when it was charged. Incidentally, this action, if it does occur practically, would seem to provide a theoretical basis—apart from the need for heating the stack, etc., in the early stages of a blow—for the practice occasionally met with of reducing coke charges after the first six or seven have been placed.

It is clear that the heat balance will be affected greatly, if much of the theoretically transferred carbon is blown out of the stack unburnt. If it were all blown out, then for equal volumes of CO_2 and CO in the waste gases, a tapping temperature of 1,425 deg. C. and waste gas temperature of 425 deg. C., the iron-coke ratio would be 10.3 to 1, instead of the 15.4 to 1 given in the Paper.

Further, the gain postulated in the Paper, following the use of a low-velocity blast, will be greatly reduced. In fact, judging from the results given in Mr. Dawson's letter, published on July 15, there would seem to be some justification for the hypothesis that a high-velocity blast gives higher thermal efficiency than a low-velocity blast, though a lower casting efficiency. It is possible that, with high-velocity blast, the initial change from CO_2 to CO is less complete than with a low-velocity blast. There were two variables, however, in the above test results, so that it is probably unwise to speculate on the causes of the changes recorded.

Whether any of the carbon is wasted as described can be checked by waste gas analysis with that end in view. I do not recall having seen such an analysis giving carbon content.—Yours, etc.,

F. W. NEVILLE.

Vulcan Works, Blackfriars, Manchester.

Contracts Open.

Llanelly, September 18.—(5) Castings, for six months from October 1, for the Corporation. The Borough Surveyor, Llanelly.

Middlesbrough, September 13.—Castings, for the Streets Committee during six months commencing October 1, 1926. Mr. S. E. Burgess, borough engineer and surveyor, Middlesbrough.

Montevideo, October 28.—Tool steel in bars; Muntz metal in bars and sheets; bolts and nuts, washers, rivets, nails, screws, etc.; copper tubes, weldless; engine packing; iron bars and sheets; files; superheater tubes for boilers, for the National Administration of the Port of Montevideo. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Ref. C.X. 2,055.)

New Companies.

Britannic Refractories Company, Limited.—Capital £1,000 in £1 shares. Directors: F. Russell, Auldam House, Worksop; W. A. Cutts, 138, Springvale Road, Sheffield; and T. Singleton, 2, Warwick Street, Sheffield.

British Metallic Packings Company, Limited, 7, Prince's Street, Westminster, S.W.1.—Capital £20,000 in 10,000 preference shares of £1 and 200,000 ordinary shares of 1s. Directors: F. C. Hibberd, 15, King's Gardens, Hove; C. P. Goode, Elmside, Oakhill, Surbiton; and C. J. de B. Sheringham, Woolston, Chorley Wood, Herts.

Ket Metal and Development Company, Limited, 75, Windsor House, Victoria Street, Westminster, S.W.1.—Capital £30,000 in £1,000 shares. Mechanical and general engineers, etc. Subscribers: G. W. King and T. W. Sims.

Company Reports.

Davis and Timmins, Limited.—Interim dividend at rate of 6 per cent., tax free, on ordinary.

Charles Clifford & Sons, Limited.—Interim dividend, 10 per cent. per annum, free of tax, on ordinary.

J. Brockhouse & Company, Limited.—Final dividend, 1s. per share, free of tax, on ordinary shares.

North British Locomotive Company, Limited.—Dividend on preference shares, 2½ per cent., less tax, for half-year.

R. & W. Hawthorn, Leslie & Company, Limited.—Final dividend on ordinary shares, 2 per cent. per annum (2 2-5d. per share), less tax, making 3 per cent. for year.

William Bayliss, Limited.—Net profit, £2,524; brought forward, £8,736; interim dividend, 3 per cent., free of tax, £1,800; final dividend, 4 per cent., free of tax; carry forward, £7,060.

Elliott's Metal Company, Limited.—Final dividend on preference shares, 5 per cent. per annum for six months; ditto, ordinary shares, 1s. per share, making 2s. per share for year, both less tax.

Parkinson and W. B. Cowan & Company, Limited.—Net profits, £69,300; final dividend, 5½ per cent., making 8 per cent., together with proportionate dividend on shares issued in March, 1925; carried forward, £28,608.

LAST THURSDAY the Brightside Foundry and Engineering Company, Limited, cast at their Newhall Works an ingot mould measuring 85½ in. by 89½ in. by 153 in., and weighing 110 tons. Blowing started at 11 a.m. and the teeming at 3.28. The metal was through the risers in six minutes. In the near future a 94-ton and a 52-ton anvil block are to be cast. In addition, an order has been booked for a 65-ton block.

Bronze Worm Gear Blanks Produced by Centrifugal Casting.*

By Francis W. Rowe, B.Sc.

The growth of the automobile industry has been largely responsible for the considerable improvements which have taken place in the design and methods of manufacture of worm-gearing. The worm-gear is the type of final drive almost universally employed in heavy petrol-driven vehicles—lorries, chars-à-bancs, and omnibuses. The experience gained and satisfaction given in service are causing the extension of its use to lighter cars for pleasure purposes, and many of the well-known makes of automobiles both in this country and abroad are fitted with worm-gearing for the final drive.

The essential features of the automobile worm-gear are a bronze worm-wheel mating with a steel worm. The chemical composition and physical characteristics of the worm and wheel must be such that the lowest coefficient of friction obtains and the minimum amount of wear takes place. Furthermore, the gearing must be capable of carrying heavy loads involving high compressive and bending stresses. It will be seen, therefore, that the duties are very arduous, and the selection and production of satisfactory units calls for careful consideration from a metallurgical standpoint.

It has been found that the best combination in service is a case-hardened steel worm mating with a cast bronze or phosphor-bronze wheel. Such a unit gives a low coefficient of friction and possesses the necessary mechanical strength. As the duties of the worm-wheel are in some ways analogous to that of an ordinary bearing, the choice of a suitable bronze is limited. Whilst considerably higher strength in the worm-wheel could be obtained by using a material having greater compressive, tensile and bending strength than cast bronze, no such material has yet been found which possesses the same good anti-friction properties and consequent resistance to wear.

Various forged and cast, high-tensile brasses, forged and cast "aluminium-bronzes," and forged aluminium alloys have been tried, but none has equalled bronze and phosphor-bronze, and only die-cast "aluminium-bronze" has approached them. As it is essential to ensure long wear to have good anti-friction properties, it is necessary for the bronze to have a correct microstructure in addition to a suitable chemical analysis. As is generally recognised, alloys the structures of which consist of crystals of homogeneous solid solutions do not give good service as bearings, owing to their high coefficient of friction, and it is essential that the alloy be built up of crystals of dissimilar hardness. Bronze and phosphor-bronze answer this requirement, and their long-recognised value for bearings and similar parts is generally attributed to this feature.

Composition of Bronzes for Worm-Gear.

The author believes that the only alloy other than bronze and phosphor-bronze which has met with any success as a material for worm-gearing is the copper-aluminium alloy containing approximately 10 per cent. aluminium. This has been extensively used in the United States for one of the popular 1-ton lorries, and in that particular unit appears to have given good service. The same manufacturer, however, uses phosphor-bronze for the heavier duty and more important vehicles. It is also used for similar service by one of the largest manufacturers in France. Die-cast "aluminium-bronze" has undoubted attractions in that the cost of the alloy is much less than that of a true bronze, and the strength properties are considerably better. This allows of a lighter wheel. The general consensus of opinion is, however, that considered *in toto* as a material for worm-gear "aluminium-bronze" is by no means so good as the bronzes and phosphor-bronzes. The author has had the benefit of the experience of the largest manufacturers of die-cast "aluminium-bronze" in the States (who are also large manufacturers of worm-wheel blanks in true bronzes), and this opinion is generally confirmed by them.

There is, of course, the possibility of further research on "aluminium-bronzes," which may result in modifications of composition and structure to give as good anti-friction properties as the bronzes; but, whilst experiments are being actively pursued both in this country and abroad, no results have yet been obtained which would justify substitution of an alloy of the "aluminium-bronze" type for the ordinary bronzes for this particular work.

Experience in service has tended to confine the composition of ordinary bronzes for worm-gear within fairly narrow limits. Practically all the worm-gearing now being commercially produced is found to fall within the limits given below:—Tin, 10-13; lead, 0-2; zinc, 0-2; phosphorus, 0-1.0; and nickel, 0-4 per cent.; copper, remainder.

EFFECT OF VARYING COMPOSITION ON STRUCTURE AND PROPERTIES.

Effect of Tin.

It has been shown by Stockdale that copper is capable of holding up to 15 per cent. of tin in solid solution. In normal foundry practice, however, equilibrium is never established, due to the comparatively rapid rate of cooling. In ordinary circumstances separation of the α-δ eutectoid occurs at a tin content of 6-7 per cent. Thus a plain bronze containing 10-13 per cent. tin consists of crystals of α-δ eutectoid embedded in a matrix of α solid solution. The α solid solution is considerably softer than the eutectoid, having a Brinell hardness (500 kg.) of from 50-70, according to the casting and cooling conditions. Actual hardness determinations of the α-δ eutectoid are somewhat difficult to make, but it would appear that the hardness is between 200 and 230 taken on a similar scale. Thus such an alloy gives what is considered a desirable structure—hard particles embedded in a softer matrix.

It is generally assumed that the effect of such a structure is that, in service, the hard particles stand out in relief, and thus only a portion of the full area is in actual contact with the steel and the coefficient of friction is thus low. The quantity of tin used is governed chiefly by strength considerations. The higher the tin content the greater the general hardness of the alloy, the greater the brittleness and the less the resistance to shock. Generally the tin content is kept as high as possible consistent with the necessary toughness being obtained. For most designs of worm-wheels 13 per cent. tin (in a plain bronze) is the maximum that can be allowed. Above this quantity the brittleness of the alloy is such that the weight of wheel would have to be exceptionally heavy to secure immunity from fracture by shock in service. The toughness or otherwise of the alloy is also very appreciably affected by the proportion of elements other than tin and by the casting conditions. These points are dealt with in later portions of the Paper.

Effect of Phosphorus.

The primary function of phosphorus in a bronze is commonly supposed to be that of securing a deoxidised alloy. Whilst this effect may be obtained by careful practice, great care should be exercised in interpreting the action of phosphorus in a bronze. The mere presence of even a large quantity of phosphorus in a bronze is no guarantee that oxides are absent. The author has known numerous cases where the bronze contained so much oxide as to render the mechanical properties extremely poor, although amounts varying from 0.2 to 0.7 per cent. of phosphorus were present. Phosphorus, whilst efficacious in removing suprous oxide from molten copper, appears quite unable to

* A Paper read last Friday before the Liege meeting of the Institute of Metals, the author is Metallurgist to Messrs. David Brown & Sons (Huddersfield), Ltd., Huddersfield.

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reduce tin oxide. Consequently, if the metal is melted and handled in such a manner that tin oxide is permitted to form, the addition or presence of phosphorus exercises little or no deoxidising action. The presence of phosphorus, however, quite apart from questions of deoxidation, improves the casting properties of a bronze. Quite small quantities noticeably improve the fluidity and decrease the liability to porous places in uneven sections. In ordinary sand-casting practice much smaller runners, gates, and risers are necessary if an appreciable quantity of phosphorus is present.

Pure copper is capable of holding approximately 0.17 per cent. of phosphorus in solid solution. The solubility of phosphorus, however, in the α solid solution of copper-tin alloys, containing above 8 or 9 per cent. tin, is very low, certainly less than 0.03 per cent. In such alloys containing 0.03 per cent. phosphorus the light blue particles of copper phosphide (Cu_3P) are easily discernible under the higher powers of the microscope. These crystals of copper phosphide, whilst considerably harder than the α solid solution matrix, are not so hard as those of the α-δ eutectoid. Measurements and calculations made by the author in different ways have shown the Brinell hardness of the copper phosphide crystals to be about 130

FIG. 1.—SECTION OF SAND-CAST BRONZE WORM WHEEL BLANK, 2.75 IN. × 2.5 IN. × 1.8.

NOTE.—Etched with $(NH_4)HO$ and H_2O_2, and afterwards with Fe_2Cl_6.

(500 kg.) as compared with 200-230 for the α-δ eutectoid.

The effect of phosphorus on the physical properties is very marked, quite small amounts increasing the brittleness of the alloy and reducing the elongation in the tensile test. This characteristic has an important bearing on the class of product under discussion. As was previously mentioned, the toughness of the alloy is the limiting feature of the tin content. If an appreciable quantity of phosphorus is present a corespondingly less amount of tin is permissible—if immunity from failure by shock in service is to be secured. Thus, for the normal designs of worm-wheels, the author's findings have been that to obtain similar toughness from an alloy containing 0.4 per cent. phosphorus to that of a plain bronze containing 12 per cent. tin, the tin content must be reduced to 9.0-0.5 per cent. The results of some experiments in this direction are embodied in Table I.

It will be seen from this table that the effect of the phosphorus on the general hardness of the bronze is approximately that which might be expected, taking the hardnes of the phosphide at the figure already quoted. It has been generally held that the good anti-friction properties of phosphor-bronze were largely due to the copper phosphide content, but close observation of service conditions coupled with other work has not shown this to be so, at any rate with bronze for worm-wheels. A high phosphorus content is permissible only when the tin is proportionally low; that is, if it is desired to have a fair amount of phosphide present the α-δ eutectoid must be reduced in amount. Of the two constituents the α-δ would appear to be the more desirable, due to its greater hardness, and to have the maximum amount of this present together with toughness the phosphorus must be low. Thus the general trend of the best manufacturers is to have just sufficient phosphorus present to ensure deoxidation and the

TABLE I.—*Single Blow Impact Tests on Bronze and Phosphor-Bronze, with Brinell Hardness Determinations. Bars sand-cast 1 in. square and machined to 20 mm. square. Three standard B.E.S.A. notches.*

No.	Composition.		Ft.-lb. to Fracture.	Brinell Hardness (500 kg.).
	Tin.	Phosphorus.		
1	10.3	0.02	65	74
2	11.65	0.04	53	86
3	12.33	0.03	48	92
4	13.08	0.04	41	103
5	9.26	0.43	42	78
6	10.43	0.37	38	84
7	11.87	0.62	24	93
8	12.92	0.55	21	108
9	10.03	1.41	14	112

necessary fluidity. This is secured by amounts of the order of 0.08-0.25 per cent.; with a phosphorus content of 0.08 per cent. it is possible to have a tin content of 12.5 per cent. for sand-castings and 11.75-12.0 for chilled-castings. With the higher phosphorus (0.25 per cent.) the tin can be 11.5 per cent. for sand-castings and 11.0 for chilled-castings.

Effect of Zinc.

Zinc, in the quantities used in this type of bronze, is generally admitted to exert a deleterious influence on the anti-friction and wearing properties. It does, however, improve the casting properties of the alloy, and is used by some manufacturers for this reason. There is less likelihood of drawn and porous places when zinc is added, and the runners and risers may be somewhat less in area. It should not be used in conjunction with an appreciable amount of phosphorus.

Worm-wheel blanks are made in Great Britain from an alloy containing 13 per cent. tin and 1.0-1.5 per cent. zinc. The blanks from this alloy are made by ordinary sand-casting methods.

Zinc dissolves in the α solid solution, and appears to lower somewhat its solubility for tin. The generally accepted theory is that the zinc causes an increase in hardness of the α solid solution, and thus the essential difference in hardness between the α and the α-δ eutectoid is lessened. Whether this be true or not, several authenticated cases have come to the author's knowledge where bronzes containing between 1.5 and 3.5 per cent. zinc have given decidedly inferior service to bronzes of similar composition, but free from this element.

Effect of Lead.

The addition of lead to a bronze for anti-friction purposes undoubtedly improves these qualities, due to the softening of the bronze, the load-carrying capacity is reduced. The insoluble lead particles have a somewhat similar function to the soft α solid solution matrix; that is, in service they form depressions and act as pockets for lubricant, and so help to maintain the essential oil film. Leaded bronzes are, of course, very extensively used in engineering for bearings. Unfortunately, the presence of an appreciable quantity of lead lowers the yield point in compression, and also the actual permanent deformation under given load. Table II gives the results of several determinations on this effect. As it is essential to have a high load-carrying capacity for worm-gear, it is usual to have the lead content not above 0.3 per cent.

Effect of Nickel.

The addition of nickel to worm-wheel bronze is a comparatively recent development, which emanates from the United States. Whilst nickel undoubtedly improves the physical properties, as shown by the usual tests, tensile strength, elongation, etc., it has not yet been definitely proved that improved wearing and anti-friction properties result from its use.

Effect of Different Methods of Casting on the Structure and Physical Properties of Worm-Gear Bronze.

As it would be impossible in a short Paper of this description to discuss fully the effect of variation of composition and size of section on the structure and properties of gear-wheel bronze cast by different methods, the author will confine his observations to worm-wheel blanks cast from metal of the composition given below, which is the standard for normal work in the foundries with which the author is associated:—Tin, 11.75-12.0; lead, 0.25 max.; zinc, 0.20 max.; and phosphorus, 0.101-0.14 per cent.; copper, remainder.

TABLE II.—*Effect of Lead on the Compressive Strength of Bronzes.*

Test-pieces cut from Worm-Wheel Blanks 1.129 in. diameter × 1 in. Blanks sand-cast, except No. 5, which was centrifugally cast.

No.	Composition.			Load for compression of	
	Tin.	Phosphorus.	Lead.	0.1 in. Tons/in.².	0.2 in. Tons/in.².
1	11.55	0.027	0.65	23.4	36.3
2	11.68	0.039	1.86	22.1	34.9
3	11.44	0.025	3.40	21.2	32.9
4	11.51	0.030	0.11	24.6	38.5
5	11.51	0.030	0.11	31.9	49.2

Unless otherwise specified, the test-bars, microsections, hardness, and density determinations have been obtained from a standard blank, which is an annular ring 14 in. outside diameter and 8.5 in. inside diameter, the depth being 2.5 in. The size of this standard ring should be taken into consideration when studying the photomicrographs.

Sand-Cast Blanks.

Although, for all normal sizes of worm-wheels, the ordinary sand-casting methods are not now employed in the foundries with which the author is connected, standard blanks of the dimensions outlined above are cast from time to time for experimental and comparative purposes. The physical properties which may be reasonably expected from test-bars cut from such a blank are given in Table III.

Naturally, due to the large cross-section, such results are inferior to those obtained from smaller sized test-bars where the comparatively rapid rate of solidification makes the metal stronger, particularly if this rapid solidification is followed by slow cooling. The disadvantages of the sand-casting methods for this work may be summarised as follows:—

(*a*) *Low Hardness and Density.*—It will be seen that the comparatively slow rate of solidification which obtains by ordinary sand-casting methods results in low general hardness and density. Variation in casting temperature may cause wide differences in these figures, as the author has previously shown. The highest density and hardness, other things being equal, is obtained with a low casting temperature, which shortens the period of solidification. Unfortunately, very low casting temperatures enhance the difficulties of founding, particularly if somewhat complicated designs of uneven section are being dealt with. Porosity troubles and drawn places in such castings may often occur through the employment of a low casting temperature.

TABLE III.—*Comparison of Physical Properties Obtained by Various Methods of Casting.*

	Sand-Cast.	Ring Chill. Inside.	Ring Chill. Outside.	Die-Cast.	Centrifugally Cast.
Yield point, tons/in.²	8.9	8.7	13.1	13.5	15.9
Maximum stress, tons/in.²	15.8	14.3	17.0	19.8	24.2
Elongation, per cent. on 2 in.	11.0	7.0	2.5	3.0	10.0
Brinell hardness (500 kg.)	86.0	84.0	110.0	118.0	124.0
Density	8.41	8.32	8.78	8.77	8.89
Izod impact (20 mm. × 20 mm. notched) ft.-lb.	33.0	17.0	15.0	16.5	27.0

(*b*) *Danger of Lower Density and Hardness at the Roots of the Teeth.*—In general, worm-wheel blanks are cast as plain rings, and the teeth subsequently cut. Commercial considerations necessitate that the wheels be kept as light as possible consistent with having the necessary strength, with the result that the pitch line of the teeth (which carries the heaviest load) generally corresponds very nearly to what was the centre of the casting. The centre portion is the most likely to be unsound, particularly if the blank is of appreciable section, and thus that portion of the gear which should possess the highest hardness and density is more likely to possess the lowest. It should be mentioned at this stage that after the teeth are cut they are polished, and each one is subjected to scrutiny with a hand-glass; the slightest trace of porosity is sufficient to cause rejection. The macrostructure and microstructure associated with such physical properties are shown in Figs. 1, 2 and 3. The grain-size is fairly large, and the α-δ eutectoid particles are large and comparatively coarsely dispersed. Consequent on these features, the sand-casting process is adopted only in such cases where, due to size or peculiarity of shape the following processes are not applicable:—

(*To be continued.*)

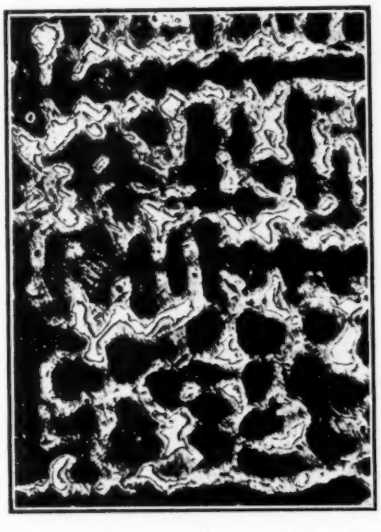

FIG. 2.—SAME AS FIG. 1. SHOWING DENDRITES. × 100.

FIG. 3.—SAME AS FIGS. 1 AND 2. SHOWING SIZE AND DISTRIBUTION OF α-δ EUTECTOID. × 200.

NOTE.—Etched with $(NH_4)HO$ and H_2O_2, and afterwards with Fe_2Cl_6.

Foundry Management, Organisation and Costing.—(II.)

(*Continued from page* 380, *Vol.* 33.)

By M. E. Nicholls.

The foundry must have a definite policy, which must be developed to the utmost, but not altered without the most careful consideration. It is not wise for the founder to imagine that, because he has a foundry, he can cast anything, suitable for any requirement, for it cannot be done. There are limits, and those limits must be clearly defined and kept; within them the policy can be developed.

While the modern foundry must be constructed and equipped on modern lines, the old-standing foundry has to be carefully treated in regard to re-construction and re-equipment, unless, of course, it is demolished to make way for an entirely new edifice. But many founders are not in a position to do this; they are desirous of re-arranging and re-equipping the foundry, inside the original building, but unless they are careful they will go too far, and make matters worse than they were before.

It is, however, useless getting up-to-date if no good purpose will be served. And this is where the policy comes in. When it is known just what is going to be catered for, then the foundry can be re-arranged to suit the requirement, and, as efficiency is the keynote of enterprise, it follows that, be the foundry large or small, efficiency must be the goal to aim for.

When a large modern foundry is constructed, people imagine that this is the beginning of the end for a number of small old-standing concerns which are apparently behind the times, and they marvel as time goes on that they are still in existence. Really, there is nothing to marvel at, for these foundries have a policy which carries them through in spite of keen competition and the advantages enjoyed by the more modern foundries. It is the foundries without a policy that succumb.

There are two foundries—one, the latest thing in foundries, equipped upon the most modern lines and capable of producing good castings in large quantities, and the other, a small old-standing foundry that looks the same to-day as it did twenty years ago. Yet it is a fact that the latter foundry can produce a certain type of casting of a superior quality, and at a lower price, than can the large modern foundry, for all its undoubted advantages. That small foundry declined to be squeezed out or submerged; it had a policy, and that policy has carried it through.

It did not attempt the impossible. The proprietor knew that for certain types of castings he could not compete with rivals equipped with modern appliances, unless he, too, modernised his foundry. It must not be inferred that his foundry equipment was hopelessly out of date, for he was progressive, and had moved with the times, but only within recognised limits. He saw that, if he was to remain an active competitor, he would either have to modernise beyond those limits, or concentrate wholly upon certain types of castings, and he decided upon the latter course, and undoubtedly, in modern production, specialisation pays.

It is a mistake to assume that the day of the small foundry is past, for with wise management, it is a power to be reckoned with, and will continue to be so. It has to be remembered that the expenses of the small foundry are relatively small, and, so long as the impossible is not attempted, it will more than hold its own. Modernise it by all means, and bring it up-to-date for the purpose it has to serve, but do not introduce innovations likely to prove superfluous, and which will be a liability instead of an asset.

Attempting the impossible lands the foundry proprietor into all sorts of difficulties, and involves him in unnecessary expense, apart from doing real harm to his business. The following will serve as an illustration. One foundry undertook to supply a certain casting at a given price, assuming that the moulding could be done on a machine. It was a fairly large casting, and machine moulding had not been attempted by the foundries which hitherto had produced them, but the foundry manager in this instance was certain it could be done, and in due course produced a sample casting, which was approved by the customer. Instead of following this up with a small consignment, however, the foundry manager waited until he had produced fifty castings before making a delivery, and then there was trouble with the customer because they were not up to the sample. A good deal of correspondence ensued, and at length the customer agreed to accept the castings (under protest) with the proviso that no future consignment would be accepted that was not up to the sample. Lest this should appear to be an arbitrary proceeding, it may be said that the sample was not so good as the castings received from other foundries, but it was quite usable, and acceptable on account of the urgent need of large quantity deliveries, which this foundry had promised. As subsequent castings were unsatisfactory, the order was ultimately reduced to cover the quantity of castings accepted, this, at the request of the foundry manager, who had by this time convinced himself that he could not produce a satisfactory casting by machine moulding.

So the foundry lost not only the order in question, but all orders from that same customer for other castings, many of which could have been produced to the satisfaction of the customer. This shows the folly of attempting the impossible. It may be contended that the impossible was not attempted, seeing that one satisfactory casting was produced, but there is a strong suspicion that the sample casting was moulded by hand, and that it was impossible for the foundry to continue by this method on account of the price quoted and the quantity promised each week, both of which were based upon machine moulding, and could not be adhered to were hand moulding resorted to.

It is possible, of course, for the foundry to err on the side of conservatism, and scrupulously refrain from attempting anything that had not been undertaken before. This must not be persisted in, for circumstances are for ever on the change and the foundry must cater for the circumstances, whatever they may be. The bicycle manufacturers did not stick to bicycles when they realised that motor vehicles would supersede them, and the founder does not stick to ornamental gates when he finds they are going out of favour. When this fact is apparent to him, he looks round to see to what purpose he can apply his plant, and when he is satisfied he has discovered the purpose he readjusts his policy and makes what rearrangements are necessary for the new undertaking.

Many scores of foundries have in recent years been reconstructed to cater for the needs of the motor industry; but how many of them are already considering what is to be done when the demand in that connection begins to fall off? This is a possibility which must be considered in the future, by some foundries at all events, for even if the motor industry does not experience a slump, it is certain that there will be no substantial advance, and orders for castings will be distributed among a lesser number of foundries than at present.

When the demand for anything is insistent, all likely channels are made use of, but as things begin to settle down a finer discrimination is shown, and some channels are pronounced better than others. Obviously, the best channels will be made the most use of, and it is certain that ere long many foundries which are now busy in consequence of the boom in the motor industry will experience a marked falling off in orders, and will have to look around for fresh business.

This is where the importance of having a policy is again demonstrated, for it recognises just when the need arises to suit fresh business. It is of no use shutting one's eyes to the obvious; of no use carrying on, fearful of what might happen, but hoping that it might not. The foundryman must know when he has served his purpose in one direction, and also in what direction he must turn his activities. If he is wise, he will not waste time in appealing to sentiment; in deploring the fact that, now he has served his turn, he is about to be thrown over. If he has been of service to his customers, they have been of equal service to him, so the obligation (if any) is mutual.

(*To be continued.*)

A Continuous Malleable Iron Annealing Furnace.*

A tunnel-type continuous annealing furnace of a new design for annealing malleable castings was placed in operation early in April by the North-Western Malleable Iron Company, Milwaukee. This furnace is of the open-fire or semi-muffled type, in this respect differing from other tunnel kiln annealing furnaces, which are of the fully muffled type. The furnace was designed and built by Holcroft & Company, Detroit.

An outstanding feature of this furnace is in the design of the tunnel, which, instead of being built solid from the floor, is open the full length on both sides from the bottom of the sand seal to the floor level. The car tops form the bottom of the kiln. The sand seal extends the full length of the kiln on each side.

The side of the kiln rests on girder and plate members extending above the floor, leaving a 14-in. open space along both sides of the kiln extending down to the floor. This permits a free circulation of air under the cars, so that the wheels and bearings are exposed to the atmosphere and there is no need of water- or air-cooling pipes.

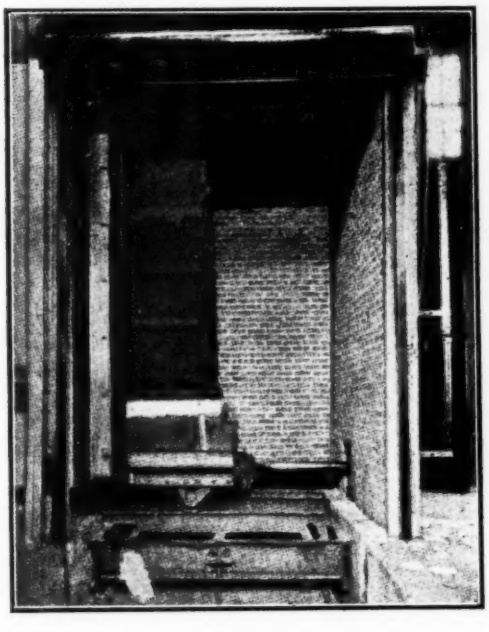

FIG. 1.

Car entering the oven at the charging end. The vestibule door is left raised to show the operation.

In addition to providing for the circulation of air under the kiln, a pit with openings at both ends extends the length of the kiln beneath the car track. This permits access to the bottom of the cars, so that bearings or wheels can be replaced or other repairs made to the cars without shutting down or interfering in any way with the operation of the kiln. An axle can be jacked up and repairs completed before the time comes for the car to be moved along the track by the charge of another car into the kiln. The cars are well insulated, and, with the air circulation beneath the kiln, it is stated that the temperature of the car bearings never exceeds 105 deg. C. Keeping the bearings comparatively cool is expected to prevent much bearing trouble.

This kiln was designed for annealing 25 tons of castings per day. Other tunnel-type continuous annealing furnaces have been built with considerably larger capacity, but the builder of this furnace was of the opinion that a kiln of 25 tons capacity would be more practical than a larger kiln that perhaps could not be operating at capacity except during periods of peak production. While designed for a daily capacity of 25 tons, its output since its operation started has averaged 28.8 net tons of good castings. Its fuel consumption has been 2,600 cub. ft. of gas per gross ton of iron.

Contrary to the rather common experience when equipment of a new design is placed in operation, it is stated that no troubles have developed in the operation of the kiln, and that it has turned out good iron from the start. The kiln is used largely for annealing miscellaneous railway truck castings and rear-axle housings for automobiles.

The over-all length of the kiln is 210 ft., the length of the kiln itself being 180 ft. At each end is a vestibule through which cars are charged and discharged. The height of the tunnel is 7 ft. 6 in. above the car top. The tunnel is divided into a 20-ft. preheating zone, a 75-ft. heating and soaking zone, and an 85-ft. cooling zone.

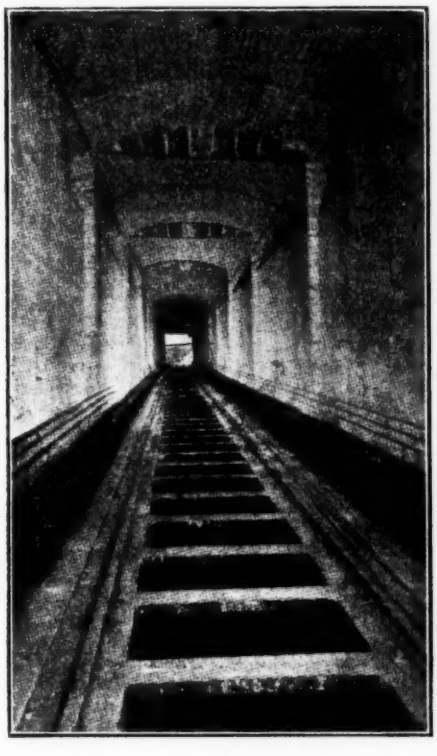

FIG. 2.

The tunnel is open on the sides to 14 ins. above the floor of the oven and a pit is provided the full length of the track. Air circulates around the truck wheels, which are thus kept cool, repairs can be made beneath the car whilst in the oven, and without interruptions in operations. There are burner outlets on each side.

The tunnel is built of fire brick and insulated brick, and is entirely enclosed in a structural steel I-beam and plate frame. The pit beneath the tunnel is 6 ft. deep and 3 ft. 6 in. wide, and has concrete walls and floor. Above the pit are 6-in. channel cross ties, at a level with the top of the track rails. The outlet flues are located near the charging end, all products of combustion passing up through a stack at that end.

The cars have structural steel sub-structures with cast-iron tops and a superstructure of fire-clay blocks and insulating brick. They are approximately 7 ft. wide, 6 ft. long, and 3 ft. high. The wheels have roller bearings. The track gauge is 4 ft. 2½ in.

* Extracted from an article which appeared in "The Iron Age" under the caption "Unusual Tunnel Annealing Furnace."

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Operation of Furnace.

No packing is used, the castings being placed in the pots loose. The pots are of standard design, 20 in. high, and have trunnions at two diagonally opposite corners to permit lifting with a crane. The average weight of the castings placed in each pot is 400 lbs. A car is loaded with 24 pots in six stacks, four pots high. The loaded car weighs about 22 tons, of which 5 tons is in castings.

A loading and unloading track extends along one side of the kiln and pots are handled with a 3-ton electric travelling crane built by the Harnischfeger Corporation, Milwaukee. There is a short transfer track at each end, by means of which a Fordson tractor moves cars outside the kiln. Used for both pulling and pushing cars, the tractor has a steel-plate bumper at the front end, which permits its use for pushing. Before entering the kiln the cars pass through a height gauge conforming to the clearance inside the tunnnel, to avoid danger of cars being loaded higher than the top of the kiln.

After a car is pushed into the vestibule the rolling curtain vestibule door is closed. The door in the kiln then is opened and the car is pushed into the kiln by a hydraulic-type ram, supplied by the Oilgear Company, Milwaukee. A car being pushed into the tunnel pushes the other cars along. A kicker cylinder under the track provided near the discharge end pushes the end car out on to the transfer, thus doing away with the necessity of using pinch bars. The Oilgear system is used also for operating the charging and discharging doors.

Temperature at the charging door, in the preheating zone, is 340 deg. C. This comes up to a maximum of 925 deg. in the soaking zone and at the discharge end of the cooling zone it is approximately 480 deg. The first manifold, starting at the charging end, is set for 815 deg., the second for 895 deg., and the last two each for 925 deg. Temperature controls are all located in the heating and soaking zones. Actual readings of the temperature of the iron inside the pots can be made with a portable pyrometer.

While the kiln is being operated on a 120-hr. cycle there is a possibility that the length of the cycle will be reduced. Although designed for charging five cars a day, six cars are being charged in the kiln daily—one every four hours. Forty-eight cars are used, of which 30 are in the kiln and 18 are on the loading and unloading line. Of those in the kiln, three are in the preheating zone, 13 in the holding zone, and 14 in the cooling zone. The operating schedule makes it possible to run the kiln over a three-day layoff of the loading crew. One operator then looks after the kiln and all auxiliary equipment.

The furnace is fired with 535 B.T.U. gas, supplied by the city gas plant, which is taken at the line pressure of 2½ to 3 ozs. The gas is compressed to 10 lbs. per sq. in., two Ingersoll-Rand compressors being installed, each with a capacity of 8,500 cub. ft. per hr. These are driven by two 15-h.p. motors so connected that neither motor can drive either compressor.

Control of Gas and Temperature.

Air is inspirated by the pressure of the gas, making it unnecessary to supply air under pressure to aid in combustion. Another advantage claimed for the use of high-pressure gas is the ease of control, there being only gas, instead of both gas and air, to control. High-pressure gas also permits the use of smaller pipes for gas lines, and it is stated that there is less variation in the pressure throughout the system than with gas used at low pressure.

From the compressor the gas passes into a receiving tank in which a 15-lbs. pressure is made, and an Emco regulating valve is provided which automatically holds the pressure at 10 lbs. on the feed line to the burners. The gas-feed line, 3 in. in diameter, runs along the centre line at the top of the kiln. The distance from the compressor room to the first manifold is 300 ft.

Four manifolds are fitted, each feeding 18 burners, nine on each side of the furnace, making a total of 72 high-pressure burners. There is a 2-in. supply line for nine burners of each manifold, these extending down the side of the kiln. The burners used are No. 2 Hyperbo vertical burners, made by the National Machine Company, Chicago.

Gas control for each manifold with 18 burners is provided by a Dickson valve and two Globe manifold pressure-regulating valves above the kiln. One Globe valve is set at a 7- to 8-lbs. pressure, or to supply sufficient gas to maintain a temperature in the kiln in excess of the setting on the control instrument board, and the other is set at a 2- to 3-lbs. pressure. When the Dickson valve is closed the gas, instead of passing through the high-pressure valve, is by-passed through the low-pressure valve. The Dickson valve is automatically operated from the instrument room, and, by alternately passing through high- and low-pressure Globe regulating valves, maintains in the furnace the temperature set on the dial of the control instrument in the instrument room. Each manifold has three gauges. One is located above the kiln at the Dickson valve and one on each side at the manifold.

Thus the kiln has fully automatic temperature control. A pyrometer thermocouple, located at each Dickson valve, is wired back to a Leeds & Northrup control instrument in the instrument room, which automatically maintains the temperatures pre-determined. There are twelve thermocouples in the crown of the kiln, six in the heating zone and six in the cooling zone, connected to two Leeds & Northrup recording instruments located on the panel board in the instrument room. These instruments record the temperature at various points in the heating-up, soaking and cooling zones. There are also eight thermocouples in the side wall of the kiln, to register the heat at the level of the bottom annealing pot. In the instrument room is a miniature model of the kiln, showing the location of each car.

An advantage claimed for the semi-muffled type kiln over a fully muffled kiln is lower cost, both of installation and of maintenance, due to elimination of the muffle. It is not claimed that the fuel economy will be more than slightly better in the semi-muffled kiln than in the fully muffled type. Compared with the periodic or box-type annealing furnace, the semi-muffled type is claimed to be superior, because of a better control of temperature in the kiln, resulting in uniformity in product, reducing scale and increasing the life of the pots. It is estimated that, with this furnace, it will be possible to get 50 heats from a pot. The semi-muffled kiln, owing to the method of firing, has shown little variation in temperature between the top and bottom of the kiln.

Detroit Convention.

The party of European foundrymen visiting the Detroit Convention, which leaves Southampton by the "Lancastria" on September 12, is due to arrive in New York on September 20. They are to be received and offered a dinner of welcome at the Hotel Pennsylvania on Tuesday, September 21. Mr. Verne E. Minich, of the American Foundry Equipment Company, is chairman of the New York local Committee. Other district chairmen are Mr. Stanley G. Flagg, Jun., of Messrs. Stanley G. Flagg & Company, Philadelphia district; Mr. S. B. Cuthbert, of the Carnegie Steel Company, for the Pittsburgh district; Mr. Franklin G. Smith, of the Osborn Manufacturing Company, for the Cleveland district; Mr. W. G. Kreutz, of the Buffalo Foundry Machine Company, for the Buffalo district; and Mr. Charles Piez, of the Link Belt Company, for the Chicago district. Mr. H. Cole Estep, of the Penton Publishing Company, is co-ordinating the work of the various Committees. The German delegation, which is the largest one, is travelling in the main by the "Deutschland," which will arrive about the same time as the "Lancastria."

Accident at the Tata Steel Works.—A fatal accident recently occurred at the Tata Steel Works, Jamshedpur, India, thirteen men being killed, twelve severely injured, and three slightly injured. All those killed were Indian employees. A ladle containing 50 tons of molten metal was being emptied into a mixer, when the sling holding the ladle broke, pouring the metal on the workmen below.

Properties of the Modified Aluminium-Silicon Alloys.*

By D. Stockdale, M.A., Ph.D., and I. Wilkinson, A.M.C.T.

As the modified aluminium-silicon alloys are being increasingly used and because no very full account of their properties has as yet been published in this country, this section, which deals with the mechanical properties of sand-cast and chill-cast bars, has been added to the Paper. In America these alloys have received considerable attention during the last few years, and particular mention should be made of a very recent Paper by R. S. Archer and L. W. Kempf.†

The alloys are used in both the cast and the worked state, the use of the alloys in the form of castings predominating. For reasons which are considered later, it is the authors' view that the optimum percentage of silicon for general foundry work is about 11 per cent., although many authorities still appear to favour a somewhat higher percentage of silicon, namely, about 13 per cent.

In Table I are set out average mechanical properties of the modified 11 per cent. silicon alloy, together with those of two widely-used casting alloys, namely, the 92:8 aluminium-copper (3L11) and the 85:2½:12½ aluminium-copper-zinc alloys (2L5).

From Table I it will be seen that although the tensile strength of the silicon alloy is of the same order as that of the 3L11 and 2L5 alloys, it is much superior from the point of view of resistance to shock, of ductility, and of lightness. The authors desire to emphasise the high Izod figures, as they reveal a characteristic of these alloys to which little or no reference appears to have been made elsewhere. On the other hand, the silicon alloy has a lower elastic limit and fatigue strength. The total linear shrinkage of the three alloys is about the same, but it would appear that the crystallisation shrinkage of the silicon alloy is less than that of the others; at any rate, the silicon alloy "fills the mould easily." It is not "hot-short," and it is not so subject to draws and cracks. Whatever the reason be, the moulder who has had experience of the three alloys appears to prefer silicon alloy for most of his castings.

In two other respects is silicon alloy very much superior to the straight copper and copper-zinc-aluminium alloys? First, from the point of view of corrosion. It has been found in the Corrosion Section of this laboratory that of the common aluminium alloys there is none which resists marine atmospheric conditions, for example, better than the silicon alloys. They are practically incorrodible not only when exposed in such a way that they are insulated from contact with other metals, but even when in contact with steel plate. Secondly, this alloy is said to be able to withstand high hydraulic pressures without leaking, a matter which has not, however, come under the writers' personal observation.

From the practical point of view there are four important factors which greatly influence the character of the product. These are:—(*a*) The concentration of the silicon; (*b*) the quantity of modifier used; (*c*) the time allowed to elapse between modifying and pouring; and (*d*) impurities.

It is proposed to discuss these points independently, but it must be clearly understood that they are intimately bound up, the one with the other.

TABLE I.—*Chill-Castings.*

Alloy.	Elastic Limit. Commercial. Tons per sq. in.	Tensile Strength. Tons per sq. in.	Elongation on 2 in.	Brinell Hardness. 2-mm. ball 20-kg. load.	Impact.		Endurance Limit. Tons per sq. in. (20 millions).	Specific gravity.
					Kg.-m.	Ft.-lb.		
			Per cent.					
3L11	7½–8½	9–11½	3–4	60	0.18–0.22	1.2–1.6	± 3.6	2.87
2L5	8–10	11–15	3–9	62	0.35–0.45	2.5–5.0	± 3.5	3.01
11 per cent. Si ..	5–6	13–14	10–15	62	0.8 –1.0	6–8	± 3.25	2.66

TABLE II.

	Percentage of Silicon.	Elastic Limit. Commercial. Tons per sq. in.	Tensile Strength. Tons per sq. in.	Elongation on 2 in. Per cent.	Reduction in Area. Per cent.	Brinell Hardness. 2-mm. ball. 20-kg. load.	Izod.		Specific gravity at 15 deg. C.
							Kg.-m.	Ft.-lb.	
Chill-Castings.	8.18	5.32	12.52	14.5	14.7	53.5	1.16	8.4	2.660
	8.92	5.44	13.28	17.8	17.6	55.5	1.38	10.0	2.661
	9.89	6.00	13.30	15.4	17.6	57.9	1.02	7.4	2.665
	11.08	6.22	13.68	12.3	13.9	60.5	1.05	7.6	2.660
	12.15	6.66	14.10	13.9	15.3	62.5	0.89	6.5	2.655
	13.12	6.20	12.94	9.2	9.5	60.0	0.62	4.5	2.647
	13.69	5.50	10.62	3.2	2.8	62.0	0.40	2.9	2.645
	14.98	5.96	10.62	2.0	2.1	62.0	0.32	2.3	2.642
Sand-Castings	8.18	4.48	10.02	11.0	12.4	43.6	1.08	7.8	2.670
	8.92	5.02	10.50	9.9	9.9	47.4	0.99	7.2	2.666
	9.89	5.50	10.80	14.5	19.5	49.8	0.97	7.0	2.665
	11.08	5.28	11.32	14.2	14.7	49.8	0.84	6.1	2.657
	12.15	5.64	11.56	12.8	11.7	54.6	0.66	4.8	2.654
	13.12	5.26	10.56	3.5	4.0	52.4	0.50	3.6	2.650
	13.69	6.14	10.98	3.4	4.1	55.5	0.51	3.7	2.650
	14.98	5.28	9.50	3.0	3.4	56.0	0.43	3.1	2.632

The Concentration of Silicon.—In Table II are given the properties of a series of alloys of varying silicon content. In this series the only important impurity was iron, of which there was about 0.3 per cent. present, and the quantity of modifier and the time factor were kept constant. These last were fixed arbitrarily, and it is quite possible that the best conditions were not chosen.

The points to be noted are that the tensile strength and the hardness increase with rising silicon content till that has risen to about 12.5 per cent., while the elongation remains approximately constant. Then these properties show a sudden, marked decrease, while the hardness remains fairly constant. The resistance to impact varies inversely as the percentage of silicon, while the density decreases linearly. The eutectic in all these alloys was "modified," but when there

* This Paper was given as an Appendix to one by Dr. Gwyer and Mr. Phillips before the Liege meeting of the Institute of Metals. The authors are associated with the British Aluminium Company.

† R. S. Archer and L. W. Kempf, "Modification and Properties of Sand-Cast Aluminium-Silicon Alloys," *Amer. Inst. Min. Met. Eng.* (Advance Copy), Feb. 1926.

was more than 13 per cent. of silicon present some silicon was in the form of large primary crystals. To that, the sudden decrease in the properties is attributed.

If special attention is paid to the quantity of modifier used and to the time factor, it is possible to prepare alloys containing up to 15 per cent. of silicon in such a way that no primary silicon is present. If that is done the tensile properties keep on increasing, and this sudden fall is delayed. Such a process is comparatively easy to carry out in the laboratory, but it is a matter of some difficulty to do it, and to do it every time without fail, in the foundry. On the other hand, it is easy to modify an alloy containing less silicon than the eutectic alloy and to keep it modified. There are two alternatives:—

(*a*) The maximum possible tensile strength and high ductility, but at the expense of shock resistance, together with an increased risk of the production of an inferior alloy.

(*b*) A tensile strength lower by about 1 ton per sq. in. than in (*a*), the same ductility, good shock resistance, together with much less risk of difficulties arising from imperfect modification or revision.

In America practice leans towards the first alternative, and there the alloy in most use contains 13 per cent. of silicon. In this country the tendency is to use an alloy containing between 10 and 11 per cent. as well, of course, as the 13 per cent. alloy

When the quantity of modifier used is large, the liquid metal becomes very viscous and does not flow well. It is difficult to skim it efficiently, and dark patches are often formed on the larger surfaces of castings.

The correct quantity of modifier is dependent on the silicon content of the alloy. The greater the quantity of silicon over the eutectic ratio, the more has to be employed. This has been shown very clearly in the recent Paper by Archer and Kempf.†

The general effect of the quantity of modifier, other variants being kept constant, on a normal alloy containing 11 per cent. of silicon is shown in Table III.

TABLE III.—*Effects of modifying Agent on strength Properties.*

Type.	Amount of Modifier.	Elastic Limit. Commercial. Tons per sq. in.	Tensile Strength. Tons per sq. in.	Elongation. on 2 in.	Reduction in Area.	Brinell Hardness. 2-mm. ball. 20-kg. load.
				Per cent.	Per cent.	
Chill-Castings. ..	None	4.72	10.26	3.1	2.8	61.0
	1 per cent. NaOH ..	5.26	12.48	6.8	6.8	61.5
	2 ,, ,, ..	5.68	13.70	8.1	8.4	62.5
	3 ,, ,, ..	3.98	13.36	11.7	12.4	62.5
	5 ,, ,, ..	3.40	13.56	12.8	13.0	63.5
	7½ ,, ,, ..	5.38	13.56	8.9	9.6	64.5
Sand-Castings ..	None	4.20	6.52	1.4	1.4	50.8
	1 per cent. NaOH ..	4.02	7.16	2.2	2.1	48.9
	2 ,, ,, ..	4.43	10.55	9.2	9.0	47.0
	3 ,, ,, ..	4.06	10.66	9.0	8.0	54.2
	5 ,, ,, ..	4.70	9.80	5.2	5.9	50.4
	7½ ,, ,, ..	4.48	10.32	Outside limits		53.5

Effect of Time.

Archer and Kempf† in America were the first to point out the importance of casting the alloys at a definite time after modifying. Their Paper should be consulted in this connection.

This discovery was made independently in this laboratory and the observations made confirm and amplify their results. The effects obtained are much influenced by the percentage of silicon and the quantity of modifier, and at present no very definite statements can be made about the subject.

The alloys can again be conveniently divided into two groups—aluminium rich and silicon rich. The properties of the first group improve slowly with the time up to about half-an-hour and then the alloys deteriorate very slowly—so slowly that good castings in permanent moulds can be made three or four hours after modification.

In the second group the improvement in the properties takes place very quickly and there is a like quick deterioration, so that castings must be made quickly.

Data referring to chill-castings are given in Table IV.

TABLE IV.—*Effect of Time factor on Chill Castings.*

Composition.	Time in minutes between Modifying and Pouring.	Elastic Limit. Commercial. Tons per sq. in.	Tensile Strength. Tons per sq. in.	Elongation on 2 in.	Reduction in Area.	Izod.		Brinell Hardness. 2-mm. ball. 20-kg. load.
						Kg.-m.	Ft.-lb.	
				Per cent.	Per cent.			
10.5 per cent. Si ..	5	6.68	13.48	8.8	9.0	—	—	—
	16	6.64	14.12	14.6	13.3	—	—	—
0.40 per cent. Fe ..	22	6.32	14.04	16.7	17.6	—	—	—
	50	6.32	13.84	17.2	20.2	—	—	—
	154	5.56	13.16	11.2	12.7	—	—	—
12.7 per cent. Si ..	1	5.00	14.08	8.5	8.3	0.92	6.7	61.5
	7	6.00	13.72	14.0	15.0	0.76	5.5	58.5
0.27 per cent. Fe ..	19	5.72	12.64	11.5	11.7	0.43	3.1	61.5
	33	5.60	12.40	9.3	9.0	0.39	2.8	60.5
	56	6.60	12.16	4.8	4.9	0.33	2.4	60.5
	88	5.20	11.64	4.0	3.8	0.21	1.5	64.5
	129	5.36	11.24	3.7	2.4	0.21	1.5	64.5

Quantity of Modifier.

This is a very important consideration indeed. There can be under-modified, correctly modified, or over-modified alloys. The structures shown by the first group may vary from "normal" through various degrees of dispersion of the eutectic, with or without primary silicon. The properties of this group are generally poor, but improve with the quantity of modifier. Then there comes a stage when the dispersion is good, and there is no primary silicon, characterised by high tensile strength, high resistance to shock, and high ductility. Further additions of modifier cause colonisation and local reversion. Such structures are associated with a serious drop in the ductility, while the resistance to shock is slightly impaired.

The Influence of Impurities.

In general the presence of impurities such as iron, copper or zinc in small quantities has little effect on the tensile strength of the aluminium-silicon alloys, but greatly impairs the ductility.

† Loc. cit.

Of these metals only iron is unavoidably present, and only the effect of iron will be discussed here. It is now easy to keep the iron content down between 0.25 and 0.5 per cent. in the alloys when they are first made. However, it is hard to stop iron wires and other iron scrap from becoming mixed with foundry scrap, and on re-melting the iron content is apt to increase. The results given in this section show that every effort must be made to avoid contamination with iron.

In alloys containing about 11 per cent. of silicon the iron is present as the constituent "X." When the iron is in less quantity than about 0.8 per cent. these "X" crystals are very small and separate out in the eutectic; if over 0.8 per cent. the crystals freeze before the eutectic and are found throughout the alloy as large plates and needles. They then give rise to planes of weakness.

Iron up to 0.8 per cent. has little effect on the tensile strength; if the quantity be increased, then the decrease is very marked. On the other hand, the ductility and the resistance to shock vary inversely to the percentage of iron irrespective as to whether the iron is present in the eutectic or as primary "X."

The data obtained by the examination of a series of alloys is given in Table V.

Other experimental results are given below:—

Alloy.	Method of Casting.	Endurance Limits (20 millions). Tons per sq. in.
10.0 per cent. silicon ..	Chill	± 3.10
10.0 ,, ,, ..	Sand	± 2.61
11.0 ,, ,, ..	Chill	± 3.24
11.27 ,, silicon 0.37 ,, iron	Sand	± 2.76
10.99 ,, silicon 0.76 ,, iron	Sand	± 2.84
10.53 ,, silicon 1.06 ,, iron	Sand	± 2.70
12 ,, silicon	Sand	± 2.61

Density

The density of many specimens both in chill and sand has been examined. The conclusion has been definitely reached that there is no difference in the density of a sound aluminium-silicon alloy cast in chill and that of one cast in sand. If such a difference is found it is a measure of the soundness, and this difference may be as large as 0.02 grm. per c.c. It is believed that under the conditions of casting in sand all the gas generally found in the alloy is given off, while in chill a certain quantity is retained in solution. This quantity is that which would cause a decrease in density of 0.02 grm. if it were evolved. Thus, to measure the soundness, the densities of chill-cast and sand-cast bars are measured. If there is no difference, the metal is perfectly sound. If the difference is less than 0.02 grm. per c.c. the figure obtained is a measure of the soundness; if it is greater, both the chill and sand bars may be very unsound.

TABLE V.—*Influence of Iron on Strength Properties.*

Type.	Percentage of Iron.	Percentage of Silicon.	Elastic Limit. Commercial. Tons per sq. in.	Tensile Strength. Tons per sq. in.	Elongation on 2 in.	Reduction in Area.	Izod.		Brinell Hardness. 2-mm. ball. 20-kg. load
							Kg.-m.	Ft.-lbs.	
					Per cent.	Per cent.			
Chill-Castings	0.29	10.80	4.83	13.90	14.0	15.3	—	—	61.7
	0.70	10.80	3.88	13.82	9.8	11.6	—	—	64.7
	0.90	10.29	4.48	13.38	6.0	6.2	—	—	65.3
	1.13	10.08	5.16	10.96	2.5	2.2	—	—	64.0
	1.60	10.36	3.18	8.06	1.5	1.0	—	—	68.3
	2.08	10.14	4.38	4.98	1.1	0.2	—	—	69.8
Sand-Castings	0.34	10.68	4.66	10.92	10.9	12.0	0.77	5.6	52.9
	0.55	10.82	4.68	10.74	8.4	8.5	0.51	3.7	48.9
	0.71	11.16	6.60	10.76	4.5	4.2	0.47	3.4	56.3
	0.91	11.06	6.32	8.40	3.0	2.8	0.26	1.9	55.5
	1.09	11.12	6.20	7.68	2.8	1.0	0.18	1.3	54.2
	1.42	10.73	—	4.64	1.5	0.4	0.15	1.1	54.3

Fatigue.

Many fatigue tests have been carried out on a twenty million reversal basis using a White-Souther machine. The fatigue limit appears to be nearly independent of both the silicon and the iron content within the range investigated. In general, there is excellent agreement between the tensile and other results given in this Paper and those published elsewhere, save only that the endurance figures given here are very much lower than those to be found in other literature. At present no reason can be advanced to explain this, but it should be noted that the curves obtained are very regular and that there is no internal evidence to show that these results are in error. Another feature is that the absolute endurance limit has not been reached at twenty million reversals. The curves can be expressed by the equation:—

$$S = \frac{a}{N + b} + L$$

where S is the stress, N is the number of reversals, L the limiting stress, and a and b are constants. If such treatment is legitimate, the conclusion arrived at is that the limiting stress is about one-fifth of a ton lower than that shown at twenty millions.

Below is given one set of experimental results. The alloy contained 12.38 per cent. of silicon and 0.23 per cent. of iron, and was sand-cast.

Fibre Stress. Tons per sq. in.	Number of Reversals to Fracture.
± 4.50	122,500
± 3.79	786,800
± 3.16	2,838,800
± 2.84	5,507,000
± 2.68	9,010,300
± 2.61	22,483,700 (not broken)

Fractures.

An examination of the fractures of the aluminium-silicon alloys has been made. The fracture under tension takes place along that line where the area of the aluminium dendrites to be crossed is least. It tends to run parallel to the direction of orientation of the eutectic colonies, and to run between any larger crystals of eutectic silicon or "X" constituent and the matrix in which these crystals are embedded.

Conclusions.

(*a*) The aluminium-silicon alloys are suitable for many types of castings, because, after suitable modification, they possess good properties from the moulder's point of view.

(*b*) They are remarkable for their incorrodibility, high ductility, and resistance to shock. Their elastic limit and resistance to fatigue are comparatively low.

(*c*) The best all-round combination of properties, combined with little risk of reversion, appears to be obtained by using an alloy containing about 11 per cent. of silicon.

(*d*) The iron content must be kept as low as possible.

(*e*) The properties of the alloys are affected by the quantity of modifier used, and by the time allowed to elapse between modifying and pouring. These factors can best be studied in the foundry under practical conditions.

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In this laboratory many hundreds of tests have been carried out on bars cast in chill under varying conditions. It follows that certain of these bars show what are possibly the best properties obtainable. A selection of best values is given below:—

Tensile strength	15.04 tons per sq. in.
Elongation on 2 in. ..	17.2 per cent.
Reduction in area	21.1 ,,
Brinell hardness 2/20 ..	65
Izod	1.38 kg. 10.0 ft.-lb.

Notes.

Chill-Castings.—Most of these castings were made in 3:1 ratio chills, 1½ in. in diameter and 9 in. long. The moulds were dressed with graphite. In some cases the bars were made in tapered moulds about 1 in. in diameter. The properties of the bars seemed to be independent of the type of mould used. The pouring temperature was 700 deg. C. for the 11 per cent. silicon alloy. This temperature was altered slightly, in conformity with the position of the liquidus, for the other alloys.

Sand-Castings.—The type of casting made is illustrated in Fig. I. It consisted of three bars 10 in. long and 1½ in. in diameter. Risers were

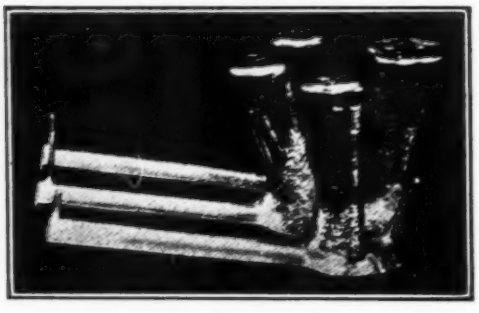

FIG. 1.—METHOD OF CASTING TEST-BARS IN SAND.

placed only at the gate end of the casting, there being vent holes at the other end. The mould was inclined at 15 deg. with the horizontal. The properties of bars cast in moulds of this design were slightly better than those shown by bars cast in a more orthodox type of mould. The moulds were dressed with French chalk, and were then dried well. They were quite cold when the metal was poured. The pouring temperature was 660 deg. C. for the 11 per cent. silicon alloy, suitable corrections again being made for the other alloys. The bars were removed from the mould eight minutes after pouring, and were allowed to cool in the air. This time of removal is a most important factor, because the bars are weakened by annealing. The practice of leaving castings in silicon alloy in the moulds over the dinner-hour or even overnight cannot be too severely condemned.

Tensile Test-Pieces.—The test-pieces recommended by the British Engineering Standards Association have been used. These test-pieces are ⅞ in. in diameter, turned down to 0.564 in. in the centre. The distance between the shoulders is 4½ in., with a radius of 3½ in. at each shoulder and a gauge length of 2½ in.

Impact Test-Pieces.—The standard British three-notch piece has been used. This has a cross-section of 10 × 10 mm., with notches 2 mm. deep. The striking energy of the machine was 3.17 kg.-m. (23 ft.-lbs.). For the more brittle alloys a striking energy of 0.69 kg.-m. (5 ft.-lbs.) was used.

Brinell Number.—The hardness of the polished, broken pieces of the impact bars was measured. Thus the figures are descriptive of the softer material very near the centre of the 1½-in. bars. A 2-mm. ball with a load of 20 kg. applied for 30 seconds was used.

Elastic Limit.—The "Elastic Limit Commercial" was measured by placing the points of a pair of dividers in marks 2 in. apart on the gauge length of the tensile test-piece, and by noticing when the test-piece apparently began to stretch.

Universal Smoke Abatement Exhibition.

Whilst thoroughly representative, this Exhibition, which opened last Monday and closes September 18, has suffered a little from the coal dispute. Roughly 25 per cent. of the exhibitors are foundrymen, which makes the show well worth visiting by our readers as it demonstrates the practical utilisation of a number of their products. A mere recital of the names gives the range of castings on exhibit, not as castings but as finished articles.

Messrs. W. T. Avery, Limited, of Soho, have a number of specialised measuring machines used in connection with power house work. Messrs. Babcock & Wilcox incorporate numerous types of their castings in their boilers. Messrs. Davidson & Company, Limited, of Belfast, who are so well-known as fan makers, are showing a flue dust collector in connection with the model boiler plant. Messrs. Keith & Blackman Company, Limited, of 27, Farringdon Avenue, London, E.C.4, are also showing a flue dust collector, but of direct interest to foundrymen is a gas-fired crucible furnace.

Another large foundry showing is the firm of G. & J. Weir, Limited, of Cathcart, who have included a number of specialities made from monel metal.

Amongst the foundries making domestic heating stoves of various kinds, there are Messrs. Belling: Cannon Iron Foundries: S. Flavell & Company, Limited: Parkinson Stove Company: and Radiation Limited. Small domestic specialities are being shown by the following foundries:—British Thompson-Houston: The General Electric Company: George Kent, Limited: and the Metropolitan Vickers concern. As usual, the representatives of Messrs. W. T. Nicholson & Clipper Company, of King Street, Salford, were rendering useful help to the other exhibitors by fastening up their belt drives.

New American Metal-Cutting Practice.

A new process that is a departure from established practice in metal cutting has been introduced at the Schenectady Plant of the General Electric Company, in the United States. This consists in the substitution of ordinary manufactured gas for acetylene, hydrogen, and other gases used in combination with oxygen. A close study of metal-cutting work was made, and a special torch was designed, which is now being used with great success for cutting risers in the steel foundry, the material cut varying from 1 to 20 ins. in thickness. The same method is also being employed on machines for cutting intricate shapes for steel plates.

Tests made have proved that manufactured gas is cheaper to use in machine cutting than either hydrogen or acetylene, and the speed of cutting after once starting is the same for all gases.

The General Electric Company states that the advantages of the use of manufactured gas are its availability, the elimination of delays and of the handling of tanks, low cost, safety, and chemical and physical properties permitting its use in a torch equipped with a superheater, which uses waste heat to advantage, thus effecting a large economy in the amount of oxygen required for the work.

THE ITABIRA IRON ORE COMPANY, LIMITED, 81, Gracechurch Street, E.C.3, have removed to 80, Gracechurch Street, E.C.3.

MR. A. POWELL, 8, Ty-Glas Road, Llanishen, Cardiff, has been appointed manager in the South Wales area for the Lancashire Dynamo and Motor Company, Limited.

ACCORDING TO PENTON'S FOUNDRY LIST, the United States possesses 4,044 grey iron foundries, 214 malleable, 357 steel, 182 electric steel and 3,316 non-ferrous foundries. Canada is credited with 413 grey iron, 16 malleable, 23 steel, 17 electric steel and 309 non-ferrous.

The Application of Payment by Results to the Foundry Industry.

By J. W. Kearsey.

(*Continued from page* 131.)

Moulding.

Moulders may be successfully dealt with by the application of individual premium bonus, the elasticity of which permits its use on almost any class of work. Rate-fixing procedure will vary with conditions of production.

An advantage possessed by premium bonus over piecework is that it permits of reduction in labour cost without "cutting" rates. Frequently jobs can be performed as quickly by lower-graded men or apprentices as by the more skilled men. Consequently, when such work has been performed by the latter class of labour, it can be transferred to the former at the same standard bonus time with a resulting reduction in unit labour cost, always, of course, with the proviso that it is carried out in the same time. If payment was made at piecework rates, no saving in production cost would be gained by such rearrangement of work.

Moulding methods can be roughly classified into three groups, viz., (1) Floor, (2) bench, and (3) machine. Each of these groups possess peculiar characteristics that necessitate special consideration when fixing bonus rates, etc.

Floor moulding is usually of a jobbing nature; numbers off each order are small, the amount of work ahead uncertain, and the methods of performance difficult to plan. Such work is impossible to analyse in detail from a time-setting aspect, not only on account of these factors, but also because the necessary equipment and tackle, suitable and available, will be an unknown quantity. An exception will occur when methods of scientific planning are applied, a refinement of production organisation that is rarely present in the foundry. The better method to use is for the rate fixer to determine a fair time for carrying out the actual moulding only, supposing that all equipment, etc., is ready to hand, and to add a certain basic percentage to this time as an allowance for preparatory work. The rate fixer must set the definite production time from his practical experience. The correct percentage on this time to allow for preparatory work will depend largely on the number of moulds to be made. Some items of preparatory work will occur only once in the production of a number of moulds, while others will recur with each mould made. The necessary allowance will vary considerably for similar work in different foundries, the amount depending entirely upon the facilities available for mechanical and manual assistance, moulding equipment, tackle, etc.

When more than one moulder is on the same job, bonus must be fixed and computed on the gang principle of premium bonus, as explained for pattern making. If apprentices are assisting moulders on a job, their time must be reduced by a grading factor, which varies according to their year of apprenticeship, to the equivalent of a journeyman's. The bonus earned for the job is calculated, and divided between the journeyman and the apprentice in the ratio of their comparative hourly rates. Apprentices should only participate in bonus after they have completed two years' service, as it will generally be found that, except on the simplest work, their assistance will be insufficient to merit any reduction in a journeyman's bonus time. The grading factors used for the different stages of apprenticeship will vary in each different foundry, according to the opportunities available for instruction and the class of work carried out.

Bench moulding is of a fairly uniform character, and standard bonus times can be set without much difficulty. Preparatory work will be at a minimum, as, owing to the lightness of the work, very little tackle is necessary. A practical rate fixer should be able to gauge moulding times for this class of work with accuracy, for he will be in a far better position to determine methods of work, available equipment, etc., than when dealing with floor moulding.

Machine moulding includes a wide range of means of production, varying from the very costly hydraulic or pneumatic power machine, capable of carrying out the whole process of moulding, to the simple and cheap hand machine, merely performing the operation of pattern drawing.

This variety offers no obstacle to rate fixing, for each job is considered individually from the point of view of production, which naturally includes the special means of carrying it out. In machine moulding, the more completely the work is mechanically performed, the greater detail into which the rate fixer will be enabled to go in his analysed predetermination of time. In fact, the methods adopted for setting bonus times become analogous to those employed in dealing with machine-shop production.

Rate Fixing for Machine and Hand Moulding.

In hand moulding, the rate fixer has only a broad idea, based on his own practical knowledge, of how the job is to be carried out. Consequently, he relies mainly on judgment. While, when setting time for machine moulding, he has specific details on which to base his calculations, for production will perforce have been planned to a considerable extent in advance. He will have information at his disposal concerning lay-out of patterns on plate, sizes of boxes required, type of machine to be used, etc., for each job. He will also have compiled analysed data, for each different machine of the time necessary to carry out certain manipulations, common to its operation, such as fixing tackle, filling certain sizes of boxes, ramming, drawing patterns, etc. It will be clear that moulding times can be estimated within very close limits of accuracy when work is handled by power machines, which reduce the actual moulding to a minimum, and even when production is performed on hand machines, which only simplify the work by mechanicalising certain minor operations and standardising general procedure, times can be predetermined with all necessary correctness for practical purposes.

Core-making.

The setting of bonus rates presents no extraordinary features. Any system of individual application may be successfully operated, although premium bonus again may claim preferential choice, if only to limit the number of different schemes for use in one foundry.

The rate fixer needs to possess expert practical knowledge of core making, as this work is very difficult indeed to standardise, and very little information can be obtained from records of past performances, unless jobs are identical. A slight alteration to a core box may have a great effect on the time necessary to make the core. This point, regarding similarity of work being no criterion to time of performance, is even more marked in core-making than in pattern-making or moulding. The value of records is nullified, and the necessity for the rate fixer to have practical experience correspondingly emphasised.

Before bonus rates are fixed, conditions of production must be definitely laid down. Various preparatory operations, essential but subsidiary to actual core-making, must be examined, and definite arrangements made as to whether their performance shall be included in bonus times, or whether they shall be done at ordinary time rate, or carried out by separate labour attached to the core bench. This work includes mixing sand, making irons, carrying cores to and from ovens, etc. Much will depend on circumstances. The method here advocated is to determine a standard time for the whole of the preliminary work, necessary for the order or batch, to divide this time by the number off, and to add this unit preparatory time to the unit time allowed for actually making the cores to form an overall unit bonus rate which will include all labour of any sort to be spent on the specific job.

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Generally, it is impossible to lay down a distinct ruling on the subject to cover the whole core-making shop, owing to conditions varying with each different type of job. Far better results will be secured by consultation between the foreman core maker and the rate fixer, with a view to deciding such questions before rates are fixed, and rigidly adhering to all decisions reached. Any failure by the foreman to conform will be a matter for the foundry manager. Such procedure, apart from its utility for rate fixing, has beneficial effects on output in general by securing systematic production, and also by the illumination of an amount of wasted time.

Fettling.

In some ways, the application of a bonus scheme to fettling presents more initial difficulties than it does to any other branch of foundry work. The causes are due to the various small and differing operations, each carried out by a different machine or hand tool, through which a casting may have to pass during the whole process; some of these are: (1) Cutting off runners, risers, etc., by oxy-acetylene, git-cutter, band saw, or hand; (2) tumbling; (3) grinding; (4) hand work: hammer and chisel, file, etc.; (5) sand blasting; (6) pickling; and (7) annealing. One method of organising production and bonus payment involves each man keeping to his machine or bench, passing the work through the different operations, and receiving a unit time or price for each operation on the various jobs.

An alternative method is to allow each man to carry the job to which he is allotted through all operations. This necessitates men constantly changing from one machine or vice to another. The first method necessitates so much detail work as to render it impossible for practical application; also, the unit time taken on the various operations will differ, and would, consequently, cause a congestion of work, preventing a smooth flow of production. This congestion will be inevitable.

The second method is rendered inapplicable in its entirety, except in very small shops, through the inequality of unit times necessary for the performance of the various operations, with the consequent difficulty of arranging for men not to require the use of the same machine at a coincident period. It has a tendency to cause both an excessive amount of waiting time and sluggish flow of production, owing to large amounts of partially finished work being held up at various stages. The latter state of conditions will be the result of an attempt to avoid the former by the commencement of the early operations on fresh jobs to fill up intervening intervals of time.

Some compromise between the two methods is necessary to formulate a smooth and satisfactory form of production control, which will permit efficient planning, secure good output, and allow easy application of a suitable bonus system. The problem devolves into a solution of the best form of apportioning work to the individual fettler.

The division of work may be carried out by allotting two or three operations as a task for one man, all machines and plant being for common use. Where the size of the shop is not large, the work can usually be divided into two operations, viz., rough fettling and finish fettling. Necessarily, the operations included in each category must be definitely specified; they will vary with the type of castings. Such an arrangement will considerably diminish the difficulties of individual bonusing, for the work of the rate fixer and the inspector will be kept within reasonable limits, the shop foreman will be allowed necessary latitude in arranging the distribution of men and jobs to machines, with the avoidance of idle time, sluggish production, and other causes of inefficiency.

Possibly it may appear that the requisite for strict planning has been advocated, but not so for merely the advantages arising from an orderly system of handling work are duly stressed. It will be admitted that, in most foundries, individual distribution of work is not systematically regulated. Production records are not kept on the score that men are so constantly transferred from one job to another that such a procedure would entail excessive clerical work. The foreman's idea is often the only criterion of a man's value, and often this, however, proves fallacious when measured by actual figures. The foreman will frequently judge a man by the quality of his work rather than by the quantity, or, shall we say, by what a man can do rather than what he does do. These points are mentioned as indications of the necessity for ascertaining individual production records, apart from their essential use for computing bonus payments.

The only objection to basing fettling bonus on individual performance is this supposed difficulty of dividing and allocating work in a manner whereby the production returns of each man can be ascertained in terms which will allow their conversion into units of measurement of value. That this procedure can not only be carried out but, further, will result in the accruing of other benefits, such as orderly arrangement of work, comparative individual efficiency, etc., it has been here attempted to show.

(To be continued.)

Modern Flexible Pipe Joints.

BY OUR ENGINEERING CORRESPONDENT.

One of the most striking inventions of the last three or four years in the whole field of pipe work, whether cast iron, wrought iron, steel, galvanised iron, or any other material commonly employed, is the "Victaulic" flexible high-pressure joint which is now being used in almost every branch of industry. Some of its applications are water, sea water, sewage, oil, petrol, benzole, household gas, compressed air, and natural gas, as well as many special uses such as in the chemical industry, giving under all temperature conditions up to 150 deg. F. a definitely tight joint within the wide range of vacuum and 2 tons per sq. in. The essential feature of the design is the use of a heavy ring of high-grade rubber composition, bent over double into the form of an inverted "U," contained within an outer metal housing ring. The pipes are made with slightly raised shoulder or small rim at each end, as supplied by any pipe founder, and the encircling metal ring is bolted round in such a manner that the lips of the inner rubber ring press down evenly all round on the flat surface of the two shoulders or rims of the pipe ends, placed loosely together, and the greater the pressure the tighter becomes the joint without interfering with the flexibility. Also the joint can be made or disconnected in a few minutes by unskilled labour, even in the dark or under water.

As regards the extent of the movement, each separate section or length of pipe can be shifted up to 5 degs. from the straight in any plans, depending on the diameter, so that in practice a long line of pipe connected in this way is flexible to a remarkable degree and can be laid merely on the rough ground without worrying about alignment.

The opportunities for such a device in the foundry are considerable. When using compressed air, for example, it is well known that the chief objection is loss by leakage, probably at least 40-50 per cent. of the total output of the air compressors is lost because of leaky rigid pipe joints. Thus the pressure contained in the average pipe line will only hold a few minutes when the valves are closed, and it is not surprising the cost of compressed air is apt to be excessive in comparison with electricity.

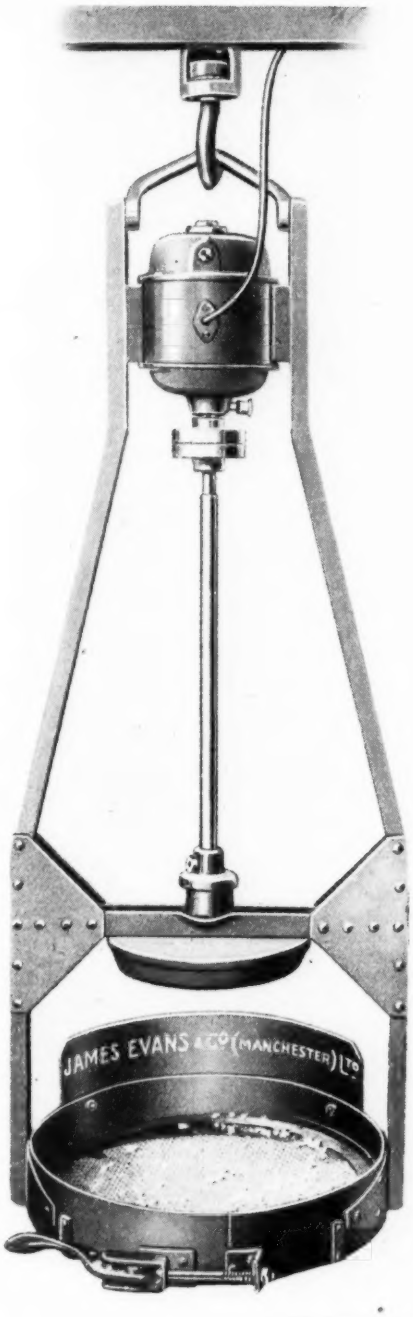
With the "Victaulic" joint this loss is almost eliminated altogether, while other typical fields are gas, water, and sewage pipe lines, marine work, both afloat and ashore (in the case of docks, harbours, and shipyards), and operations involving hydraulic pressure.

The invention is the production of the Victaulic Company, Limited, of Dean Stanley Street, Millbank, Westminster, London, S.W.1.

French International Foundry Exhibition, 1927.

It is announced from Paris that the Syndicat General des Fondeurs (the Employers' Federation) propose to organise an International Foundry Exhibition to be held in Paris in 1927, probably in the Parc des Expositions. The last one held in France (September, 1923) was organised by the Association Technique de Fonderie (the French Foundry Technical Association).

EVANS'S ELECTRIC
GYRATORY FOUNDRY RIDDLE



THE saving accomplished by the use of our Electric Gyratory Riddle pays for the cost of the machine in a few weeks' time.

It will sift more sand with one operator than six men sifting by hand. In addition to this it mixes the sand better, and produces a better grade than hand labour.

The machine is portable and may be moved to any place in a few moments (where a hook for suspension is available and electric current in service) and set in motion instantly.

Motor and working parts are all above the sieve, thus preventing the sand from interfering with the operation of the machine.

Power required, $\frac{1}{4}$ B.H.P.

JAMES EVANS & CO. (M/c) Ltd.

BRITANNIA WORKS,

BLACKFRIARS, MANCHESTER.

The Performance of Furnaces.

A Plea for More Detailed Information.

Reports which have appeared in the Press of late dealing with a new type of furnace installed in the metallurgical department of one of the leading technical schools in this country raise some interesting questions in the mind of the furnace engineer and the metallurgist of experience. A new type of melting furnace may, from the published details, display considerable ingenuity in design, and embody an excellent system of recuperation, but in all cases the interest in the actual construction of a furnace is quite secondary to performance in the industrial field, and the engineer no less than the metallurgist has cause to complain of the manner in which so many furnace problems are presented. With many accounts of new furnace developments, curiosity is piqued, interest aroused, and the critical faculties are conscious of a direct challenge.

In the case of a typical new installation, it is stated that the consumption of gas is between 33½ per cent. and 50 per cent. of that used in the ordinary gas furnace for metal melting. This is a point which no foundry superintendent would fail to appreciate in these days of rising fuel costs but if it is granted that a new system of recuperation has been evolved which is capable of effecting a very considerable saving, we are faced with the difficulty of determining what is the usual consumption of gas for the fusion of a typical metal such as brass in an ordinary furnace. A careful search through the hundreds of records and tests upon which the writer has been able to collect information during the past twenty years fails to reveal any figure which can safely be taken to represent a typical consumption, as results vary over a very wide range. For instance, within the past three months the writer was informed by one brassfounder that the gas consumption upon brass in the furnaces he has in use amounts to over 10 cub. ft. per lb., taken over the first melt, and he was loud in his complaint that this is not a commercial proposition, with which statement most foundrymen will be disposed to agree. A couple of weeks before this, the author found that another foundryman was equally emphatic in his praises of the general economy and utility of the gas-melting furnaces he used, in which the consumption of gas for the first melt amounted to 6½ cub. ft. per lb. of brass. Yet a third record out of the vast amount of material available upon this very interesting subject shows the consumption for the first melt in another type of gas furnace to be 3.8 cub. ft. per lb. A 50 per cent. saving upon the first-named result would not be a hard task for the ingenuity of a designer of normal capacity, but a similar saving upon the lowest figure would be an achievement which would arouse considerable attention in foundry and metallurgical circles. Figures have been taken upon the first heat in all cases, so as to correspond with other published details.

As evidence of what a modern gas furnace can do in the way of attaining high temperatures, a recent report states that a small crucible of brass was melted, then a small crucible of copper, and following this a small crucible of nickel: but here, again, the scientific inquirer is tempted to ask what is the objection in a technical report to naming the net weight of the different metals contained in these small crucibles. A 5-lb., a 50lb., or a 100-lb. charge are all "small" from the point of view of a man accustomed to a 500-lb. tilting furnace! Information as to the length of time the furnace took to bring down this range of metals is lacking, and equally so any details of the gas consumption for the work, although it is mentioned that in the case of the nickel ten minutes were required to reach melting-point—though not pouring point.

Such instances as described are typical of the way in which much furnace data is collected and presented, and from the many examples one encounters of isolated figures which are quite impossible to analyse or properly record by reason of the omission of other essential data, it would appear that the time is ripe for some engineering society or central authority to take in hand the preparation of a standard form of record more or less upon the lines of the well-known boiler code.

Suggested Baser.

The preparation of a thermal balance sheet, although of considerable scientific interest, is usually unnecessary for ordinary commercial purposes, for though the B.T.U. efficiency of one furnace may be 40 per cent. against 10 per cent. in the case of another system of firing, yet when the cost of operation is reduced to a common £ s. d. basis the less efficient apparatus may prove to be the most economical in fuel costs. It should be unnecessary to stress, however, that in all cases of furnace data and performance, whether the process relates to melting or heat-treating, it should be clearly indicated exactly what metal is being dealt with, the size of the furnace, and sufficient brief particulars to enable its construction to be classified, the fuel used, the pressure of air blast (if any) the gas rate per hour, the output per hour, such information being also reduced to a "gas per lb. of output" basis. Clear indication upon the time and the gas taken for the preliminary heating-up of the apparatus ought also to be given, nor is it unreasonable in many cases to expect that additional details in the shape of life of crucibles, life of furnace lining, cost of labour, etc., should also be given where available, as some of these are occasionally sufficient to put quite a different couplexion upon an otherwise satisfactory performance.

Considering the amount of fuel which is involved in the production of practically every manufactured article, it is a matter for regret that the facts and figures relating to this important subject are so often presented in a way which falls very far short of the exact method which is the rule when dealing with the performance either of steam boilers or any type of motive power, whether steam, gas, or oil, and we are forced to the conclusion that this branch of industry is badly in need of a standard form of code whose adoption would enable all new facts to be presented upon a uniform basis.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Education or Training?

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your leader of August 26 you ask for the views of employers and workmen upon the question of "Education or Training?"

I am convinced that the present system of educating the lads for the foundry industry is wrong both in the foundry and technical classes.

If to create an army of metallurgists, superintendents, managers and foremen, is the desired object of the present educationalists let them go on and we shall soon have a superabundance of metallurgists and a dearth of moulders.

The late Mr. H. Pilkington, a past-president of the I.B.F., said "All the education necessary for moulders is the three R's."

It is a well-known fact that many of the excellent moulders of the past could not write their names, yet they could and did make beautiful castings which are unsurpassed in quality to-day.

Education as now given creates a dissatisfied mind towards manual labour, and no one can excel in any craft unless he is not only satisfied with it, but happy in and proud of his craft.

Therefore it is quite evident that to get boys to take up the art of moulding or coremaking they must not dabble in metallurgy, or their interests will be divided, and both moulding and coremaking requires undivided interest and attention.

If moulders are wanted, scrap the present system: establish one to teach and train boys to be craftsmen. This could be done by each town having a foundry built, equipped and financed by the employers, with perhaps a subsidy from the Government, managed by a man of known practical experience. Here boys could be taught the craft under actual workshop conditions.

No definite period of service should be required of them, as some boys become more efficient in 6 months than others in 6 years. Thus, as these boys become useful, then they could be drafted to any employer requiring them.—Yours, etc.

AN OLD MOULDER.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

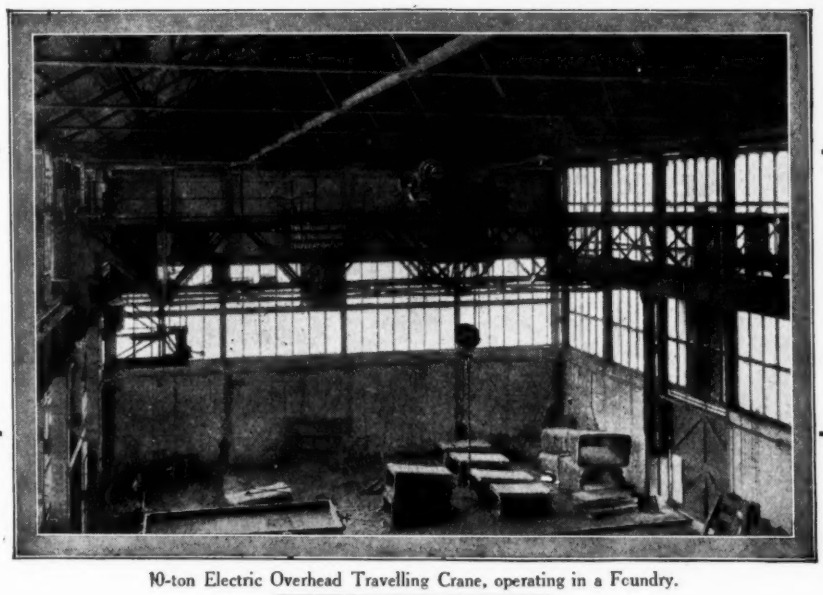
SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
Works: HALLSIDE, NEWTON and BLOCHAIRN, GLASGOW.
CONTRACTORS TO HOME, COLONIAL AND FOREIGN GOVERNMENTS.

Established 1872. *Telegraphic Address: "Steel, Glasgow."*

WELLMAN CRANES



10-ton Electric Overhead Travelling Crane, operating in a Foundry.

Illustrated Catalogues sent on request.

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STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

Trade Talk.

IT is hoped partially to restart the Dowlais Works, Cardiff, in about a fortnight with the orders which are in hand.

PALMERS SHIPBUILDING AND IRON COMPANY, LIMITED, of Jarrow and Hebburn, have secured an order for two oil tankers of 9,000 tons each for H. E. Moss & Company, Liverpool

BRAITHWAITE & COMPANY, Neptune Works, Alexandra Docks, Newport, have secured a contract from one of the South American States for the provision of approximately 22,000 tons of riveted steel water-pipes.

A CARGO of 4,000 tons of galvanised sheets and over 100 tons of copper ingots have been shipped on the "Statesman," a Harrison liner, at Swansea for Calcutta. The consignment was from the Grovesend Works, Gorseinon.

OWING to the distress prevailing in the district, the Darwen and Mostyn Iron Works Company in North Wales have been petitioned to re-open the works. It is now stated that there is every likelihood of one furnace being shortly restarted.

THE electrical engineering works of Allen West & Company, Limited, in the Lewes Road, Brighton, were damaged by fire in the early hours of Wednesday of last week during a severe thunderstorm. The building was struck by lightning.

THE DUBLIN DOCKYARD COMPANY (Vickers, Ireland) have received an order from the New Zealand Government for a motor vessel for the Pacific Islands Administration, and from the Commissioners of Irish Lights for a twin-screw vessel, with dimensions 190 ft. by 32 ft. by 15 ft. 9 in.

THE EDISON SWAN ELECTRIC COMPANY, LIMITED, announce that an offer has been made to purchase the ordinary shares of the company at the price of 13s. per share. The shares have a nominal value of 4s. each. The directors advise its acceptance by the shareholders.

AS THE RESULT of conferences between representatives of the British Mannesmann Tube Company, Limited, and Mannesmannroehren-Werke A.G., an arrangement has been arrived at between the two companies which will bring about an interchange of technical information and assistance with general co-operation.

THE GRINDING and pulverising offices of International Combustion, Limited, 11, Southampton Row, announce the receipt of orders from France for Hardinge conical ball mills, Raymond mills, three pulverisers, and one Hum-mer electric screen, while an order for one of the latter screens has been received from this country.

AN INSTANCE of quick despatch has occurred at the Great Western Railway's docks at Port Talbot. The s.s. "Basse Indre" arrived at Port Talbot at 6 p.m. on August 24 with a cargo of steel, and commenced discharging with four cranes at 8 a.m. on the following day and finished at 9.50 a.m. on the 27th, after discharging 2,000 tons. The actual time discharging was 18 working hours.

THE OUTPUT from the Clyde shipyards last month consisted of only eight vessels of 31,970 tons, which brought the total for the year to date up to 100 vessels of 203,419 tons, against 153 vessels of 389,731 tons in the corresponding eight months of last year, and 142 vessels of 440,174 in the best corresponding period on record—that of 1920—when the output was greater by 42 vessels of 236,755 tons

THE SHIPBUILDING orders booked by British firms during August include a British India liner, four or five cargo steamers and as many oil tankers, besides a couple of hopper barges, and two submarines for the Yugoslav Government, which are reported to have been placed with Sir W. G. Armstrong, Whitworth & Company, Limited. In addition, news is still awaited confirming the White Star Line building programme, the King Line orders, as well as several tankers that have been tendered for, and, finally, the Argentine naval orders, for which tenders have been submitted.

DURING the month of August there was only one vessel launched on the Wear. This was the "Silverbeech," built for the Silver Line, Limited, by Sir James Laing & Sons, Limited. She is the second vessel built on the Wear for the Silver Line, Limited, and has a gross tonnage of 5,000. This makes the total number of vessels launched on the Wear during the eight months of the present year five, with a total gross tonnage of 25,780, compared with 17 vessels of a total of 65,060 gross tons in the corresponding eight months of last year and 40 vessels of a total of 133,723 gross tons in the first eight months of 1924.

ACCORDING to "British Industries," the following new overseas contracts have been secured by members of the Federation:—Vulcan Foundry, Limited, Newton-le-Willows, Lancs., seventy-three broad-gauge locomotives and ten eight-wheeled coupled bogie locomotives, for India; also two super-heated tank engines for the Tanganyika Railways. W. T. Henley's Telegraph Works Company, Limited, North Woolwich and Gravesend, 136,000 yards of underground power, telephone, and pilot cable for the Union of South Africa Railways. Sir W. G. Armstrong, Whitworth & Company, Limited, Newcastle-on-Tyne, twenty-five heavy goods locomotives and tenders for the Queensland Government Railways; also a 10,000-ton cargo vessel, for the Canadian Pacific Railway Company. Birmingham Railway Carriage and Wagon Company, Limited, Smethwick, three dining saloons and three staff and kitchen cars for the Union of South Africa Railways. Metropolitan-Vickers Electrical Company, Limited, Manchester, high-speed electric passenger locomotive for the Great Indian Peninsula Railway. Sir William Arrol & Company, Limited, Glasgow, 50-ton floating crane for Lagos Harbour, West Africa. General Electric Company, Limited, Birmingham, high-speed electric passenger locomotive for the Great Indian Peninsula Railway. Sentinel Wagon Works, Limited, Shrewsbury, twenty-four light locomotives for the Egyptian Delta Light Railways; one 15-ton locomotive for the Bhavnagar State Railway; six 6-ton locomotives for the Madras irrigation works. Metropolitan Carriage, Wagon and Finance Company, Limited, Birmingham, one hundred and twelve covered goods wagons for the Jodhpur Railway. C. R. Turner, Limited, Langley Mill, Notts., twenty bogie wagons, for the conveyance of naphtha, for the Central Argentine Railway. R. & W. Hawthorn, Leslie & Company, Limited, Newcastle-on-Tyne, eight super-heated locomotives for the United Railways of Havana.

Obituary.

MR. J. BESTALL, commercial manager of the Codnor Park Ironworks of the Butterley Company, Limited, died recently, aged 77 years. He had been associated with the company for 62 years.

MR. J. E. LEATHER, for many years manager of the wire department at the Stocksbridge Steelworks of Samuel Fox & Company, Limited, and latterly representative of J. Stead & Company, Limited, Sheffield, died recently, aged 53 years.

MR. R. D. TATA has died suddenly while on a visit to Hardelot, France. Although a director of all the constituent companies, Mr. R. D. Tata identified himself mostly with the Tata Iron and Steel Company and the three hydro-electric undertakings.

Personal.

MAJOR SIR ASTON COOPER-KEY, who has recently retired from the position of H.M. Chief Inspector of Explosives, has been elected to the board of Allen-Liversidge, Limited.

MR. A. WILLIAMS has been appointed by Vickers Boiler Company, Limited, Broadway Buildings, Westminster, S.W.1, sales representative for the South of England in connection with industrial boiler installations and export business.

MR. JAMES MORRISON, late foundry manager to the Carron Company and James Allen, sen., & Son, Limited, Elmbank Foundry, Glasgow, has been appointed foundry manager to the Southern Foundries, Limited, Purley Way, Croydon, Surrey.

MR. J. A. MACARTHUR, who for the past 18 months has been assistant draughtsman and designer to the Macfarlane Engineering Company, Plymouth, has been appointed assistant lecturer in the electrical engineering department of the Plymouth and Devonport Technical College.

MR. C. GARFIELD ABBEY has been appointed president and general manager of the Lancashire Dynamo and Motor Company of Canada, Limited. Mr. Abbey has been connected with the Lancashire Dynamo and Motor Company, Limited, Trafford Park, Manchester, for 15 years, being first at the works at Trafford Park and latterly on the staff of the Glasgow agents, Kelsall & Parsons. We are advised that the Lancashire Dynamo and Motor Company of Canada have moved to 4, Hospital Street, Montreal, and that a well-equipped service station is being established at Montreal.

Wills.

PADFIELD, S. J., Caerau Road, Newport, foundry manager £2,420

LEEMING, J. A., lately secretary with Thwaites Bros., Vulcan Iron Works ... £1,673

MATHIESON, J. H., managing director of A. Mathieson & Sons, Limited, Saracen Tool Works, Glasgow £150,939

WHALLEY, H. L., of Rosthorne, Duchy Road, Harrogate, managing director of the Hope Foundry, Leeds, and a director of Fairbairn, Lawson, Combe, Barbour, Limited £8,163

"SERVICE GRC FIRST"

MINIMUM CORE SAND

Fine, clean, bright and easy stripping, is equally good with any binder whether solid or liquid, and is, in its way, as valuable a contribution to Foundry efficiency as is

MAXIMUM CORE SAND

for larger work.

We are producers of refractories materials of every class and description.

GENERAL REFRACTORIES Co. Ld. SHEFFIELD.

BCM/OK9 LONDON.

No need to try and remember our name in case it is unfamiliar to you. This is our British Monomark. Envelopes addressed simply thus will be delivered to us by arrangement with the G.P.O.

THE FOUNDRY TRADES EQUIPMENT & SUPPLIES ASSOCIATION LTD.

IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—Notwithstanding a much more hopeful view now entertained in market circles of an early decision of the prolonged struggle in the coal mining industry, business in the Cleveland and other pig-iron markets of the country continues deplorably idle, with prices remaining at almost famine levels, impossible to consumers save in cases of extreme urgency. It must further be recognised that even if a speedy settlement of the strike is effected, it must be several weeks before normal supplies of fuel are obtainable, so that there can be little prospect of a general restart at the blast furnaces and steelworks for some considerable time forward. A further small advance in quotations meantime indicates the upward trend of prices, which now stand as follow for home consumers :—No. 1, 93s. 6d.; No. 3 G.M.B., 91s.; No. 4 foundry, 90s.; and No. 4 forge, 89s. 6d. per ton.

The hematite position on Tees-side is practically unchanged. The output is now restricted to two furnaces, and the stocks, particularly of mixed numbers, of other makes are substantially lower. Still, there is some iron to meet current requirements, but the quotation for mixed numbers is higher at 83s., with the No. 1 quality at 83s. 6d. per ton. On the North-West Coast prices are unchanged, and are firm at the old rates, Bessemer mixed numbers being quoted at £4 4s. c.i.f. Welsh ports, £4 8s. 6d. per ton delivered at Glasgow, £4 12s. 6d. per ton delivered at Sheffield, and £5 to £5 2s. 6d. per ton delivered at Birmingham. With regard to exports, the shipments of pig-iron from the Port of Middlesbrough during August amounted to only 5,331 tons—4,243 tons foreign and 1,088 tons coastwise—as compared with 6,736 tons—4,520 tons foreign and 2,216 tons coastwise—in July, a decrease of 1,405 tons.

LANCASHIRE.—Consumers of foundry pig in this area are now entirely dependent upon supplies of Tees-side and Scottish No. 3 qualities, of which fair quantities are held by merchants, current values ruling at about 105s. for the first-named, with a small premium for the latter. Practically all ironmakers in the Derbyshire district are now quoting for delivery when production is again possible at 87s. 6d. to 90s. per ton, delivered Manchester or equal, the price at the furnaces being 80s. per ton.

THE MIDLANDS.—In the Birmingham area a moderate demand for iron for foundry purposes is still in evidence, and many consumers have recently made heavy purchases from Continental works for September shipment. Prices of this iron still vary considerably, and quotations are anything from 90s. to 95s. per ton delivered local stations. Most of the iron offered conforms closely to Northants and Middlesbrough No. 3 analysis.

SCOTLAND.—Conditions in this locality remain quiet, but prices are firm and unchanged at 90s. for No. 3 foundry at the furnaces. Generally speaking, consumers are only buying from hand to mouth. Founders are fairly well employed, and still able to carry on.

Finished Iron.

Business, as far as manufactured material is concerned, is at present almost in complete abeyance, very many of the mills and forges normally employed in these departments being, for obvious reasons, temporarily out of action. In some areas, however, notably in South Staffordshire, where the mines are operating on a daily increasing scale of output, it is hoped soon to resume manufacturing, but marketable supplies continue very restricted. Some producers who have a little stock are not seeking buyers very keenly, and when they part with the iron, the sales are on the basis of about £13 for crown bars, which compares with £11 to £11 5s prior to the strike. There are now limited stocks of finished iron in the makers' hands in the majority of districts. Some special high-quality irons have been produced this month, and have found a market at practically famine prices, which are too unrepresentative to be worth quoting.

Steel.

The markets for all descriptions of semi and finished products are necessarily for the time being in an unsettled condition, stocks everywhere having been reduced to very limited proportions, with dealings in acid and basic billets few and far between. Sheffield, however, holds a fair quantity of Swedish material, and this is being bought with a certain amount of freedom in the absence of home supplies. A fair lot of crucible steel is being produced in Sheffield, and more electric steel is available. At Glasgow two of the sheetmaking firms are busy at work and find no falling-off in the demand.

Scrap.

Transactions in all descriptions of scrap metal, both ferrous and non-ferrous, of late have been of unimportant volume, and with the solitary exception of cupola material for foundries there seems quite an absence of demand. In Scotland even heavy machinery cast-iron scrap and heavy ordinary cast-iron scrap is somewhat easier, as some of the foundries are curtailing their regular deliveries. Prices at Glasgow range about as follow: Cast-iron borings, 48s. 6d. per ton; machinery cast-iron scrap, 75s. to 76s. 6d. per ton; heavy ordinary cast-iron scrap, 70s. per ton; old cast-iron railway chairs, 74s. per ton; light cast iron and firebars, 59s. per ton, all delivered f.o.t. consumers' works.

Metals.

Copper.—The recent decrease in consumptive demand in home industries must be accepted as an adverse factor in checking activity in buying in the market for standard copper, but, curiously, has had little effect upon actual prices, which remain comparatively steady. The statistical position, however, is quite good, and consumption on the Continent, helped by the excellent demand in America, is quite sufficient to offset the heavy decline in the consumption in this country, due to the great industrial decline.

Official closing prices of standard copper have been as follow :—

Cash: Thursday, £58 17s. 6d. to £59; Friday, £59 to £59 2s. 6d.; Monday, £59 2s. 6d. to £59 5s.; Tuesday, £59 2s. 6d. to £59 5s.; Wednesday, £59 2s. 6d. to £59 5s.

Three Months: Thursday, £59 12s. 6d. to £59 15s.; Friday, £59 15s. to £59 17s. 6d.; Monday, £59 17s. 6d. to £60; Tuesday, £59 15s. to £59 17s. 6d.; Wednesday, £59 15s. to £59 17s. 6d.

Tin.—Buying for the cash position in standard tin during the past week has been on a more restricted scale, but quotations have been firmly maintained on the whole, seldom fluctuating much below the £293 level of the last fortnight, and generally above that average. The statistical position continues favourable, another small increase being reported in the home stocks to 1,357 tons, of which about one-third is Straits tin, the balance of the stocks consisting of English, which is almost entirely held at Liverpool. Tin is comparatively dear, being, roughly, £32 a ton over the average for last year, but stocks are dangerously small, and the autumn demands may precipitate an advance to a level as high as it was earlier this year.

Official closing prices of standard tin have been as under :—

Cash: Thursday, £293 10s. to £293 15s.; Friday, £294 5s. to £294 10s.; Monday, £298 10s. to £298 15s.; Tuesday, £300 5s. to £300 10s.; Wednesday, £301 10s. to £301 15s.

Three Months: Thursday, £289 15s. to £290; Friday, £290 7s. 6d. to £290 12s. 6d.; Monday, £294 5s. to £294 10s.; Tuesday, £296 to £296 5s.; Wednesday, £295 10s. to £295 15s.

Spelter.—Notwithstanding the adverse influence of unsettled labour conditions quotations in this section of the market are fairly well maintained. A trade circular states: Recently there has been more inquiry from consumers, and the situation on the Continent having improved, there has been an advance in prices. America eased off under the influence of our market, but consumption there is still good, although with the increased number of retorts operating it is possible that there will be more spelter available for export.

The following are the week's prices :—

Ordinary: Thursday, £34 5s.; Friday, £34 2s. 6d.; Monday, £34; Tuesday, £34 2s. 6d.; Wednesday, £34 2s. 6d.

Lead.—The weakness in soft foreign pig is partly ascribed to some Continental selling on speculative account, and the position is still rather unsettled, although there is not a great deal of surplus lead hanging over the market. The United Kingdom imports for the first seven months of this year were 153,803 tons, this indicating a deficit of about 3,200 tons, as against the same period last year.

The week's prices are appended :—

Soft foreign (prompt): Thursday, £32 5s.; Friday, £32 12s. 6d.; Monday, £34 15s.; Tuesday, £32 11s. 3d.; Wednesday, £32 8s. 9d.

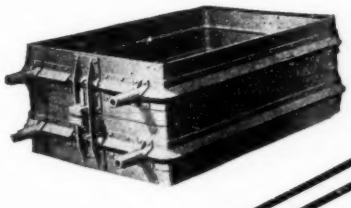
FOR

JOBBING FOUNDRIES

There is no better moulding box than the STERLING ROLLED STEEL BOX for all classes of jobbing work requiring boxes up to 48 inches square or 48 inches diameter. They are LIGHT—ACCURATE—STRONG.

With considerably less effort your moulders will turn out more work—and far better work, if you give them STERLING BOXES.

STERLING BOXES are not pressed from a sheet but are made from a strip of solid ribbed steel bar of special section. This, with malleable iron pinholder and handle fittings makes the lightest box possible consistent with the great strength necessary to stand up to the usage of the jobbing foundry.



Have your standard run of jobbing boxes made by STERLING and bring your foundry into line with your competitors.

STERLING FOUNDRY SPECIALTIES LTD.
BEDFORD

London Office: 13, VICTORIA STREET, S.W.1.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash ..	59	2	6
Three months ..	59	15	0
Electrolytic	66	15	0
Tough	64	15	0
Best selected ..	65	5	0
Sheets	90	0	0
India	73	0	0
Wire bars	67	5	0
Do. Sept.	66	15	0
Do. October ..	66	15	0
Ingot bars	66	15	0
H.C. wire rods ..	70	0	0
Off. av. cash, Aug.	58	18	4½
Do., 3 mths. Aug.	59	13	7½
Do., Sttlmnt, Aug.	58	17	7½
Do., Electro. Aug.	67	1	10½
Do., B.S., Aug. ..	66	0	10
Aver. spot price copper, Aug. ..	58	17	7½
Do., wire bars, Aug.	67	6	8

Solid drawn tubes 13d.
Brazed tubes .. 13d.
Wire .. .. .. 9½d.

BRASS.

Solid drawn tubes .. 12d.
Brazed tubes .. .. 13½d.
Rods, drawn .. .. 11½d.
Rods, extd. or rlld. .. 7½d.
Sheets to 10 w.g .. 10½d.
Wire .. .. .. 10½d.
Rolled metal .. .. 9½d.
Yellow metal rods .. 7½d.
Do. 4 × 4 Squares 8d.
Do. 4 × 3 Sheets .. 8½d.

TIN.

Standard cash ..	301	10	0
Three months ..	295	10	0
English	300	0	0
Bars	301	5	0
Straits	307	5	0
Australian		—	
Eastern	302	7	6
Banca		—	
Off. avr. cash, Aug.	291	16	1½
Do., 3 mths., Aug.	282	2	3½
Do., Sttlmt. Aug.	293	14	6½
Aver. spot., Aug.	293	14	6½

SPELTER.

Ordinary	34	2	6
Remelted	33	5	0
Hard	28	15	0
Electro 99.9 ..	37	7	6
English	24	15	0
India	31	0	0
Zinc dust	43	0	0
Zinc ashes	16	0	0
Off. aver., Aug. ..	34	6	11½
Aver., spot, Aug.	34	3	5½

LEAD.

Soft foreign ppt.	32	8	9
English	33	15	0
Off. average, Aug.	32	11	0½
Average spot, Aug.	32	15	1½

ZINC SHEETS, &c.

Zinc sheets, English	42	15	0
Do. V.M. ex whf.	39	15	0
Rods	45	0	0
Boiler plates ..	39	0	0
Battery plates ..	38	10	0

ANTIMONY.

Special brands, Eng.	74	10	0
Chinese	64	0	0
Crude	43	0	0

QUICKSILVER.

Quicksilver .. 15 5 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon 25%	6	3	0
45/50%	10	0	0
75%	17	0	0

Ferro-vanadium—
35/40% .. 15/- lb. va.
Ferro-molybdenum—
70/75% c. free .. 5/3 lb.
Ferro-titanium—
23/25 % carbonless 11½d.
Ferro-phosphorus, 20/25%, £17 0 0
Ferro-tungsten—
80/85%, c.fr. .. 1/4½ lb.
Tungsten metal powder—
98/99% .. 1/10½ lb.
Ferro-chrome—
2/4% car. .. £33 0 0
4/6% car. .. £22 0 0
6/8% car. .. £21 10 0
8/10% car. .. £20 15 0
Ferro-chrome—
Max. 2% car. £37 0 0
Max. 1% car. £43 5 0
Max. 0.70% car. £54 10 0
70%, carbonless 1/5½ lb.
Nickel—99%, cubes or pellets .. £170
Cobalt metal—98/99% 10/- lb.
Aluminium 98/99% £118
Metallic Chromium—
96/98% .. 3/3 lb.
Ferro-manganese (net)—
76/80%, loose £14 0 0
76/80%, packed £15 0 0
76/80%, export £14 0 0
Metallic manganese—
94/96%, carbonless 2/- lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten .. s. d. 2 6
Finished bars, 18% tungsten .. 3 0
Per lb. net, d/d buyers' works.
Extras—
Rounds and squares 3 in. and over .. 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Do. under ¼ in. to ⅛ in. .. .. 1/- lb.
Flats, ½ in. × ½ in. to under 1 in. × ⅛ in. 3d. lb.
Do. under ½ in. × ½ in. 1/- lb
Bevels of approved sizes and sections 6d. lb.
Bars cut to length 10% extra
Scrap from high-speed tool steel—
Scrap pieces .. .. 3d.
Turnings and swarf 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Hvy. steel	2	7	6 to	2	12	6
Bundled steel & shrngs.	2	2	6 to	2	5	0
Mixed iron & steel	2	2	6			
Heavy cast iron	3	0	0			
Good machinery for foundries ..	3	5	0			
Cleveland—						
Heavy steel ..	3	9	0			
Steel turnings ..	2	6	0			
Cast iron borings	2	5	0			
Heavy forge ..	4	2	6			
Bushelled scrap	3	10	0			
Cast-iron scrap	3	9	0 to	3	12	6
Lancashire—						
Cast-iron scrap	3	2	6 to	3	10	0
Hvy. wrought ..	3	2	6			
Steel turnings ..	2	2	0			

London — Merchants' buying prices delivered yard.

Copper (clean)..	49	0	0
Brass (clean) ..	39	0	0
Lead (less usual draft)	28	0	0
Tea lead ..	24	0	0
Zinc	23	0	0
New aluminium cuttings ..	80	0	0
Braziery copper	45	0	0
Gunmetal ..	46	0	0
Hollow pewter	190	0	0
Shaped black pewter ..	138	0	0

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast—
Foundry No. 1 .. 93/6
Foundry No. 3 .. 91/-
Foundry No. 4 .. 90/-
Forge No. 4 .. .. 89/6
Hematite No. 1 .. 83/6
Hematite M/Nos. .. 83/-
N.W. Coast—
Hem. M/Nos. d/d Glas. 88/6
„ d/d Birm. 100/- to 102/6
Midlands—
Staffs. common* .. —
„ No. 4 forge .. —
„ No. 3 foundry —
Shrops. basic .. .. —
„ Cold blast, ord.* —
„ „ roll iron* .. —
* d/d Birmingham.
Northants forge .. .. —
„ fdry No. 3 .. —
Derbyshire forge .. —
„ fdry. No. 3 .. —
„ basic .. .. .. —
Scotland—
Foundry No. 1 .. —
„ No. 3 .. 90/-
Hem. M/Nos. .. .. —
Sheffield (d/d district)—
Derby forge .. .. —
„ fdry. No. 3 .. —
Lincs. forge .. .. —
„ fdry. No. 3 .. —
E.C. hematite 95/-
W.C. hematite .. 92/6
Lincs. (at furnaces)—
Forge No. 4 .. .. —
Foundry No. 3.. .. —
Basic .. .. .. —
Lancashire (d/d eq. Man.)—
Derby forge .. .. —
„ fdry. No. 3 .. —
Northants foundry No. 3 .. .. .. —
Dalzell, No. 3 .. .. 110/-
Summerlee, No. 3 .. 107/6
Glengarnock, No. 3 .. 107/6
Gartsherrie, No. 3 .. 107/6
Monkland No 3 .. .. 107/6
Coltness, No. 3 .. .. 107/6
Shotts, No. 3 .. .. 107/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom. ..	11	10	0 to	13	0	0
Angles				12	0	0
Tees to 3 united ins.				12	10	0
Nut and bolt iron				—		
Hoops				14	10	0
Marked bars (Staffs.) f.o.t. ..				14	0	0
Gas strip				12	10	0
Bolts and nuts .. ¾ in. × 4 in. ..				15	5	0
Steel—						
Ship plates				8	2	6
Boiler plts. ..				11	5	0
Chequer plts. ..				9	15	0
Angles ..	7	7	6 to	7	10	0
Tees ..	8	7	6 to	8	10	0
Joists ..	7	7	6 to	7	10	0
Rounds and Squares 3 in. to 5½ ins. ..				9	0	0
Rounds under 3 in. to ⅜ in.				8	12	6
Flats, over 5 in. wide and up ..				9	10	0
Flats, 5in. to 1½in.				8	10	0
Rails, heavy ..				8	10	0
Fishplates				12	10	0
Hoops (Staffs.) ..				10	10	0
Black sheets, 24g.				11	5	0
Galv. cor. sheets, 24g.				16	15	0
Galv. fencing wire 8g. plain				12	10	0
Billets, soft ..				—		
Billets, hard ..				8	2	6
Sheet bars				—		
Tin bars d/d ..				6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	4
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks ..	9d. to 1/5½
Ingots rolled to spoon size ..	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated. Dols.

No. 2X foundry, Phila.	21.76
No. 2 foundry, Valley	19.26
No. 2 foundry, Birm.	21.00
Basic	19.26
Bessemer	19.76
Malleable	19.26
Grey forge	18.76
Ferro-mang. 80% d/d	88.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	2.00
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.50
Sheets, black, No. 28..	3.10
Sheets, galv., No. 28 ..	4.25
Sheets, blue an'l'd, 9 & 10	2.30
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry .. .. —
„ furnace .. .. —
Durham & North.
„ foundry .. .. —
„ furnace 50/- to 52/6
Other Districts, foundry .. .. —
„ „ furnace (basis) —

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	23/6
„	28×20, „	47/-
„	20×10, „	—
„	18¾×14, „	—
C.W.	20×14, „	—
„	28×20, „	—
„	20×10, „	—
„	18¾×14, „	—

Terneplates 28×20, — per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£18/10 to £19/0
Rolled Ord.	£15/10/0 to £16
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12

Pig-iron £6 0 0 to £6 10 all f.o.b. Gothenburg.

TUBES AND FITTINGS.
Up to and incl. 6 in.

	Tubes	*Fittings*
Gas ..	60%	.. 50%
Water ..	55%	.. 45%
Steam ..	50%	.. 40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Sept. 2	58	17	6	dec. 5/-
,, 3	59	0	0	inc. 2/6
,, 6	59	2	6	,, 2/6
,, 7	59	2	6	No change
,, 8	59	2	6	,, ,,

Electrolytic Copper.

	£	s.	d.	
Sept. 2	66	15	0	dec. 5/-
,, 3	66	15	0	No change
,, 6	66	15	0	,, ,,
,, 7	66	15	0	,, ,,
,, 8	66	15	0	,, ,,

Standard Tin (Cash).

	£	s.	d.	
Sept. 2	293	10	0	dec. 40/-
,, 3	294	5	0	inc. 15/-
,, 6	298	10	0	,, 85/-
,, 7	300	5	0	,, 35/-
,, 8	301	10	0	,, 25/-

Tin (English ingots).

	£	s.	d.	
Sept. 2	292	10	0	dec. 30/-
,, 3	293	5	0	inc. 15/-
,, 6	297	10	0	,, 85/-
,, 7	299	5	0	,, 35/-
,, 8	300	0	0	,, 15/-

Zinc Sheets (English).

	£	s.	d.	
Sept. 2	42	15	0	No change
,, 3	42	15	0	,, ,,
,, 6	42	15	0	,, ,,
,, 7	42	15	0	,, ,,
,, 8	42	15	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
Sept. 2	34	5	0	dec. 5/-
,, 3	34	2	6	,, 2/6
,, 6	34	0	0	,, 2/6
,, 7	34	2	6	inc. 2/6
,, 8	34	2	6	No change

Lead (English).

	£	s.	d.	
Sept. 2	33	10	0	dec. 5/-
,, 3	33	15	0	inc. 5/-
,, 6	34	0	0	,, 5/-
,, 7	33	15	0	dec. 5/-
,, 8	33	15	0	No change

AVERAGE MONTHLY PRICES OF WEST COAST HEMATITE MIXED NUMBERS.

Year.	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1885	44 0	44 1	43 2	43 1	42 10	42 6	42 6	42 0	42 2	42 1	43 0	43 8	42 11½
1886	43 3½	42 0	42 0	41 6½	41 2½	40 0	40 0	41 2½	41 6	44 0	44 0	44 9	42 2½
1887	49 6	48 9½	45 6	43 2½	43 6½	44 1	44 0	44 2½	43 5½	41 6	41 9½	45 0	44 6½
1888	44 4	42 3	42 1½	42 0	41 2½	42 1½	42 6½	44 0	45 8½	44 6	44 6	45 9½	43 4
1889	44 4	45 2	47 3½	48 9½	48 6½	48 7½	50 1½	53 11	55 3	63 6	73 10	73 2	54 4½
1890	76 1½	65 1	63 3	55 1	53 9½	50 11	52 3½	56 4	58 0	58 2	57 5	54 4½	58 5
1891	52 9	50 10	48 11	47 9½	51 5	50 6	50 10	48 4	50 1	49 1½	48 3½	47 8	49 8½
1892	47 4	45 6	46 4½	47 8	49 5	50 4½	49 7½	49 10½	49 10½	48 8½	46 10	46 1½	48 2½
1893	46 0½	45 8	45 11	45 7	44 11	44 9½	44 10	45 3	45 0	44 6	44 7	45 8	45 3
1894	45 3	45 3	45 1½	45 1	43 11	43 11	43 9½	44 2	44 7½	43 7	43 5	43 3	44 3½
1895	42 8	42 5½	42 6	42 10	43 10	43 7½	44 10	45 11	49 11	48 9	47 7½	47 7½	45 2½
1896	47 0	48 9	48 9	48 2½	47 3	47 3	46 10	46 10	47 2	48 5	50 7	50 6	48 1½
1897	51 2	49 10	48 5	47 4	47 9½	48 6	47 0	47 3	47 3	47 0	48 3½	47 11	48 2
1898	48 9	48 10	49 4	49 8½	50 10	50 3½	51 0	52 5	53 11	55 8	57 3	56 10	52 1½
1899	59 1	59 9	57 7	59 6	64 7	70 10½	76 7½	72 2	74 3	75 0	78 1½	73 3	68 5
1900	75 3½	76 10	79 10	84 6	81 4	79 1½	83 4	81 5	79 11	76 10	77 8½	68 4	78 8
1901	60 2	59 0	57 9½	57 6½	57 8	57 4½	57 8	61 0	60 0½	59 9	58 7½	56 7	58 7½
1902	56 1	57 9½	59 3½	59 9	59 10½	60 0	60 0	60 8½	61 5	61 2	59 3	59 0	59 6
1903	58 5	58 8	61 1	59 5	57 10	57 3	56 7	56 3	55 9	54 8	52 4	52 4	56 8½
1904	52 8½	53 1	53 7	54 9	54 2	53 2½	52 9	52 5	52 2½	52 7	53 1	55 11½	53 5½
1905	57 9½	56 9	58 1	58 2	56 4	55 8	55 5½	56 7	61 0	68 9	69 9	70 11½	60 5½
1906	70 4½	65 2½	63 4½	63 9	64 5	64 6	64 1	66 2½	67 3	69 4½	72 4½	78 8½	67 5
1907	77 9	72 11	71 10	73 9	79 9½	76 9	77 9	78 4	75 11	72 9½	68 6	66 7	74 4
1908	62 7	59 1	61 6½	61 6½	61 4	59 1	57 9½	56 11	60 2	59 2	58 5½	57 7	59 7½
1909	51 4	56 5	55 3	56 1	56 4	57 0	56 8	58 0	61 0	61 1½	60 7½	61 4	58 1½
1910	64 0½	64 3½	66 10½	67 6½	66 2½	65 4	64 4½	65 6½	65 2	64 10½	64 6	65 6	65 4½
1911	66 9	66 1	64 10	63 1	62 1	62 0	61 2	62 2	62 1	61 1	61 10	64 0	63 1
1912	67 0	67 0	67 0	69 3	71 9½	72 11	75 9½	79 1½	82 2½	85 0	85 3½	86 6	75 9½
1913	86 6	86 6	86 3	85 0	83 6½	80 10½	78 1	76 10½	72 6	71 0	68 0	65 3	78 4½
1914	64 6	65 4½	65 6	64 11½	64 2½	64 0	64 0	68 11½	74 6½	71 0	65 4½	69 9½	66 10½
1915	78 9	100 6	103 1	113 6	111 9	114 0	116 3	115 2½	113 8½	121 1½	131 9½	139 6½	113 3
1916	135 0	135 0	133 4	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	129 2½
1917	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1918	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1919	127 6	127 6	127 6	127 6	180 6	184 3	195 4½	204 6	204 6	204 6	204 6	204 6	174 7
1920	224 9	235 0	245 0	275 0	290 0	295 0	295 0	295 0	295 0	295 0	295 0	280 0	284 11½
1921	263 4	228 4	180 0	180 0	180 0	160 0	160 0	157 6	142 0	128 6	121 0	115 0	167 9½
1922	125 0	117 6	115 0	115 0	115 0	115 0	113 1½	104 0	105 0	105 0	106 3	110 0	112 1½
1923	109 0½	116 5½	133 11½	138 3½	134 2	125 0	115 7½	111 9	110 0	110 0	113 11	115 0	119 5½
1924	115 0	115 0	114 4½	112 6	112 6	112 6	111 0	110 0	110 0	105 4½	102 6	102 6	110 3½
1925	102 6	102 6	100 0	98 6	97 6	95 1½	92 6	90 6	88 3	87 0	88 1½	88 0½	94 3½
1926	90 1½	90 0	89 8½	89 0	89 0	89 0	90 2½	91 9	—	—	—	—	—

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NON-FERROUS METALS

COPPER, TIN. LEAD, SPELTER, ANTIMONY, CHROME ORE

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ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

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SITUATIONS VACANT AND WANTED.

ADVERTISER, progressive organiser, with long practical experience of Foundry, Pattern Shop and general Engineering, desires management of small works, or responsible position with larger firm.—Replies to Box 790, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ADVERTISER desires change; 22 years' experience foundry pattern shop, also machine shop, as Foreman, Draughtsman, Checker, and Chief Inspector; alive to modern methods of mass production, chiefly aluminium and iron motor cylinders.—Box 802, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY MANAGER, aged 38, disengaged October 31, seeks progressive position; present duties include control of foundry working on piecework system; output is varied and consists of all classes of Grey Iron, White Iron, Chilled Work and Malleable Castings; able to produce at competitive prices, mix to analysis, practical cupola experience.—Box 800, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

METALLURGIST required for Engineering Works in the West of Scotland to supervise the various Heat Treatment Departments, in which are handled a variety of Small Forgings, Carburised Machined Parts, Small Tools, etc.; applicants must have a thorough knowledge of the most up-to-date practice in heat treatment of all classes of steels, and should have actual experience in the application of scientific methods in operating heat treatment processes on a quantity production basis; give particulars of age, training and experience; the right man liberally treated.—Box 794, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATTERNMAKER required for small works doing general foundry work.—Reply, stating experience and wages required, STENNER & GUNN, Tiverton, Devon.

WORKING FOREMAN MOULDER required for small jobbing foundry, Manchester district (country); must be well up in modern methods, mixing of metals, etc., good organiser; permanency to suitable person.—State age, experience and wages required, to Box 806, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EX-OFFICERS AND OTHER RANKS.

The Proprietors of the FOUNDRY TRADE JOURNAL have placed this space at the disposal of the British Legion, Officers' Association, Employment Bureau, 3-4, Clement's Inn, Strand, London, W.C.2. (telephone: Holborn 5769), to whom all replies should be addressed, quoting number of advertisement, date on which it appeared, and the name of this paper.

EX-OFFICER, single, age 31, anxious to go abroad, capable, energetic, and used to a hot climate. B.Sc. degree metallurgy. Thorough knowledge of bookkeeping, exceptionally quick at figures. (5730)

ENGINEER, aged 34, full apprenticeship Clyde and afloat, clean record, desires appointment as Shift Engineer, Power station, or as Engineer on rubber or tea estate, with prospects. (5589)

QUALIFIED MECHANICAL AND ELECTRICAL ENGINEER, A.M.I.Mech.E., with commercial training, aged 37, 20 years' experience General, Railway, and Ordnance Engineering, held responsible positions, including Works Manager, anxious to obtain position suitable to my qualifications and experience. (1337)

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PATENT YOUR INVENTIONS, Trade-mark your Goods. Advice, Handbook and Cons. free.—B. T. KING, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.). 146A, Queen Victoria Street, E.C.4. 38 years' refs. 'Phone 682 Central.

MACHINERY.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

MACHINERY.—*Continued.*

PNEUMATIC HAMMER, 5-cwt., by Peter Pilkington, Limited, belt driven, with 2 ft. dia. W.I. pulleys, 5½ in. face, all on solid C.I. base; in excellent condition; £150.—G. SCAMMELL & NEPHEW, LIMITED, Fashion Street, Spitalfields, E.1.

PUBLICATION.

IRON, STEEL, BRASS AND ALUMINIUM FOUNDERS, MANUFACTURING ENGINEERS, MAKERS OF FOUNDRY PLANT AND REQUISITES, REFRACTORIES.

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MISCELLANEOUS.

CASTING FLUX for all non-ferrous Metals. Its use is a gain, not an expense.—Write to WILLIAM OLSEN, LIMITED, Hull.

CHAPLETS.—Full range of all kinds from stock.—Send your requisitions to LAWSON WALTON & CO., LTD., Newcastle-on-Tyne.

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. Phone 264.

Phone: 4908 Central. BEECROFT & PARTNERS LTD. Grams: Retort Sheffield.
THE FOUNDRY CHEMISTS,
ST. PETER'S CLOSE,
SHEFFIELD.

Notify all Foundries that their Technically trained direct Representatives giving **Beecrofts Service** to all Foundries are now situated in **London, Birmingham, Manchester, Leeds, Glasgow, Newcastle-on-Tyne, Belfast**—thus covering all **districts** in **Great Britain.**

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